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AMERICAN MACHINIST

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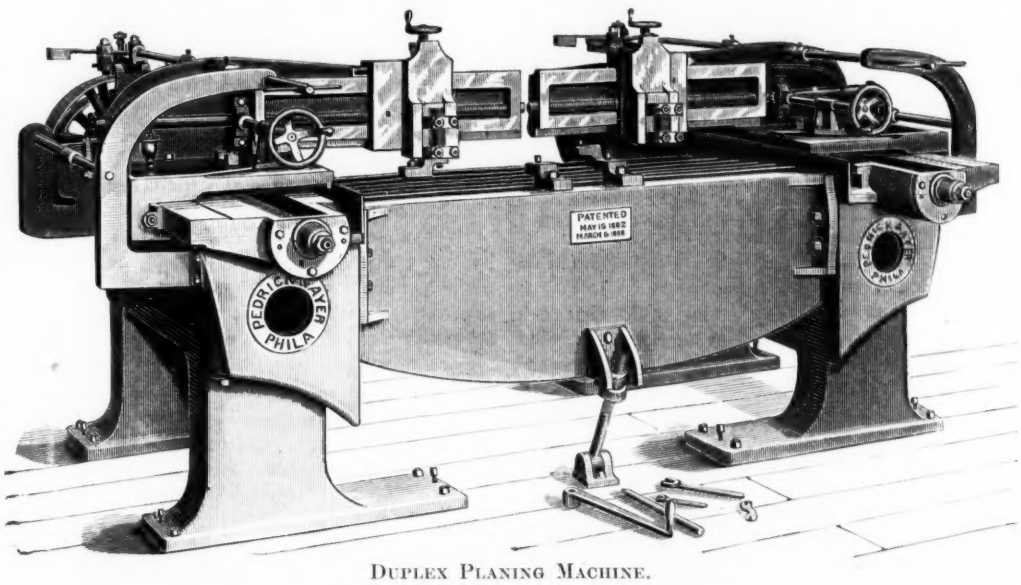
Duplex Planing Machine for Scarfing Ship Plates.

We give on this page an illustration of a duplex planing machine, built for the special purpose of scarfing plates used in the construction of iron or steel ships. Most of our readers are, of course, familiar with the Richards open side planing machine, and know that it consists essentially of a massive bed, upon which is placed a saddle carrying an arm to which is fitted the head the same as to the cross-rail of the ordinary planer. Motion is imparted to the saddle by means of a heavy screw placed in the middle of the bed under the saddle; the belts being shifted for the reverse by means of tappets, which are upon a shifting bar above the saddle.

The Newport News Shipbuilding and Construction Company wishing a machine for scarfing the ends of plates used about the stern-post and bows of vessels, the idea was conceived of accomplishing the work by combining two of these machines, as shown, and connecting them by a platen so arranged as to be adjustable to any desired taper, the usual smaller platens being dispensed with. The requirements were that sheets up to 21 feet long, 5 feet wide, should be scarfed down at the corners for a space of 6 inches in width, 15 inches long. The two machines are entirely independent, so far as their driving arrangements or handling are concerned, and both or either of them may be used as desired, plates of any length being put in from the back, and the machines handled entirely from the front. The machines are connected beneath by heavy iron beams to which they are bolted, and, of course, are further tied together by the platen, which, after it is adjusted, is firmly bolted to both. The support for the adjusting screw, seen in front, rests upon one of these beams. By means of a shaft extending out in front connected to the cross-feed screws by bevel gears, the saddles can be moved by the operator while he is in his usual position. The machine has proved very efficient in use, and the simplicity of the means by which the result is accomplished will commend itself to mechanics. The builders are Pedrick & Ayer, Philadelphia, Pa.



DUPLEX PLANING MACHINE.

The building of small steam launches is an industry of considerable importance. Most people are satisfied with moderate speed, but since it is said that thirty miles an hour has been made there will be a demand for one to beat that speed.

"Standard" Saw-mill.

The engravings on this page and on page 2 represent the latest design of saw-mill machinery built by the Standard Saw-mill Machinery Company, of Erie, Pa., the size represented having a capacity for about 8,000 feet of lumber per day, using a saw up to 60 inches diameter.

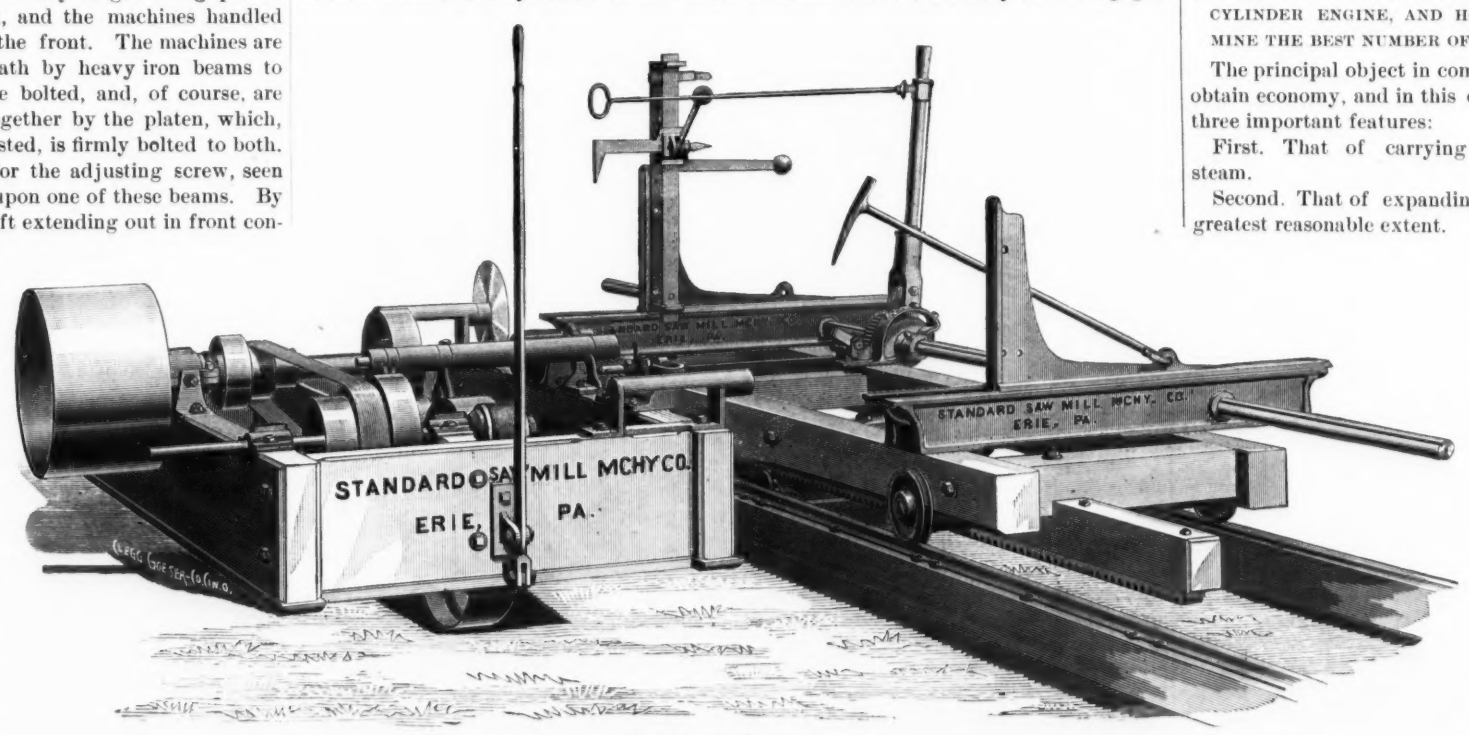
The saw arbor frame, technically known as the "Husk," is of pine, 7 feet 6 inches long, 12½ inches deep and 4 inches thick. The arbor is of steel, 2⅞ inches diameter, with a solid collar 5 inches diameter. The feed is through the medium of paper friction drums, and, by means of the cone pulleys seen, the rate of the feed can be changed from 1 to 2½ inches per revolution of saw. The rate of feed can also be changed to suit purchaser.

The carriage is 20 feet long, running on one V and one flat track 48 feet long, and having a feed rack 24 feet long.

The blocks open to 36 inches from the saw, and are provided with the new "Standard" ratchet. One is fitted with the well-known Knight dog, combining both log and last board dog, the other with the common log dog.

The ratchet is shown on an enlarged scale by the figure on page 2. Its main features are a ratchet wheel of comparatively broad face, which is operated by six steel pawls of different lengths. These pawls may be disengaged by a half turn of the setting lever, which at the same time engages the reversing pawls, to enable the sawyer to move the blocks back without leaving his place. There are also six check pawls which prevent back motion, except when it is desired, and they are disengaged. The ratchet wheel has 45 teeth, and the pawls of varying lengths give any desired movement of the blocks.

The check pawls are controlled by a lever passing over carriage, a slight push with the foot engaging or disengaging them. Also provided with a circle and with a stop, so scaled that when boards, plank or lumber of uniform thickness is being sawed, the lever can only be moved as far as set for. A quarter turn of the setting lever disengages both the forward and reversing pawls, so that a log thrown on blocks will carry the knees back, making a ratchet which is as accurate as is used on larger mills, and one which can be set over the log by the sawyer, or behind the log by the setter, with equal convenience and accuracy. This ratchet will fit any pony, small or medium mill, whose blocks are operated by a set shaft. Other sizes of these mills are made from 5,000 to 30,000 feet capacity, with or without top saws, and with other variation to suit circumstances.



STANDARD SAW-MILL.

The Teutonic, of the White Star Line, has now made the fastest ocean passage on record. She made it in five days, sixteen hours and thirty-one minutes, beating the Majestic by more than an hour and a half. Unless greater haste is made by those who propose a four-day line they may be beaten by the old lines before beginning. The best day's run of the Teutonic was 517 miles, so she has not only made the quickest passage, but also the best days' run.

Compound Engines.

BY JAMES TRIBE.

SECOND PAPER.

THE OBJECT AND IMPORTANCE OF THE MULTI-CYLINDER ENGINE, AND HOW TO DETERMINE THE BEST NUMBER OF CYLINDERS.

The principal object in compounding is to obtain economy, and in this object there are three important features:

First. That of carrying high-pressure steam.

Second. That of expanding steam to the greatest reasonable extent.

Third. That of reducing to a minimum the condensation of steam in the cylinder.

HIGH-PRESSURE STEAM.

It would be of but little value to compound unless the steam in the engine-room is at least:

For two cylinders, 65 pounds.

For three cylinders, 110 pounds.

For four cylinders, 130 pounds.

It has been many times practically demonstrated that the higher pressure steam is the more economical, providing the rate of expansion is in proportion. For instance, in a two-cylinder compound condensing, with steam at 65 pounds, the greatest number of expansions possible to a reasonable extent

would be from 10 to 12, while the single-cylinder engine will make in ordinary running about six expansions; or in a three-cylinder triple expansion, steam of 110 pounds at best would only be expanded 20 times, while as much as that might reasonably be expected from a two-cylinder compound.

I believe the best pressures are about as found in Table No. 1.

TABLE No. I.
STEAM PRESSURES FOR COMPOUND ENGINE.

	Condensing Compound.	Non-condensing Compound.
Two-cylinder engine.....	120 lbs.	170 lbs.
Three-cylinder engine....	150 lbs.	200 lbs.
Four-cylinder engine.....	190 lbs.	

EXPANDING STEAM TO THE GREATEST REASONABLE EXTENT.

The most correct way of determining the greatest number of expansions possible to steam of any pressure is to first establish what may be considered the best terminal pressure in the low-pressure cylinder. The following Table, No. 2, is proved to be very good.

TABLE No. II.
TERMINAL PRESSURES IN LOW-PRESSURE CYLINDERS.

Number of Cylinders.	Absolute Pressure.
Single-cylinder engine ...	7 lbs.
Two-cylinder engine.....	6.5 lbs.
Three-cylinder engine.....	6 lbs.
Four-cylinder engine.....	5.5 lbs.

Then if the steam pressure be limited to say 150 pounds gauge that is, 165 pounds absolute, and the terminal pressure is regarded, as per table, at six pounds absolute, apply Rule No. 1.

Rule No. 1.—Divide the absolute initial steam pressure (see Table No. 1) by the absolute terminal pressure (see Table No. 2,) and the quotient will be the total number of expansions.

Thus we have $165 \div 6 = 27.5$ expansions; but as there will be a little loss in the receiver, etc., this will be reduced to about 27 expansions. Again by the same rule, with steam pressure 120 pounds or 135 pounds absolute, and terminal pressure in the low-pressure cylinder 6.5 pounds absolute, we have $135 \div 6.5 = 20.75$, or say 20 expansions. So in the same way for a quadruple, with steam 190 pounds or 205 pounds absolute, and terminal pressure 5.5 pounds absolute, $205 \div 5.5 = 37$, or say 36 expansions.

Having the total number of expansions, to compute the approximate number of expansions on each cylinder use Rule No. 2.

Rule No. 2.—For two cylinders, extract the square root of total. For three cylinders, extract the cube root of total. For four cylinders, extract the fourth root of total.

Thus in a triple expansion engine, having a total expansion of 27, the approximate number in each cylinder would be:

$$\sqrt[3]{27} = 3.$$

From the above rules the following Table, No. 3, has been arranged for condensing engines:

TABLE No. III.
FOR CONDENSING ENGINES.

	Initial Steam Pressure, Absolute.	Total Number of Expansions.	Approximate Number of Expansions in Each Cylinder.
Single-cylinder engine...	45 lbs.	6	6
Two-cylinder engine.....	135 lbs.	20	4 5
Three-cylinder engine...	165 lbs.	27	3
Four-cylinder engine....	205 lbs.	36	2.45

REDUCING THE CONDENSATION OF STEAM IN THE CYLINDERS TO A MINIMUM.

During the expansion of the steam from the higher to the lower pressures, and the consequent change of temperature, a cylinder, cylinder head and piston will become alternately heated and then cooled to an extent varying according to the number of expansions in that cylinder. For instance, the steam enters the cylinder at an initial pressure of 150 pounds gauge, and is expanded six times. This 165 pounds absolute equals 366° at the commencement of each stroke, but by the time the piston has reached the end of the stroke the steam pressure has been reduced to 165 ÷ 6, which equals 27.5 pounds, or 245°, showing a reduction in the temperature of 121 degrees.

STANDARD SAW-MILL.—SEE PAGE 1.

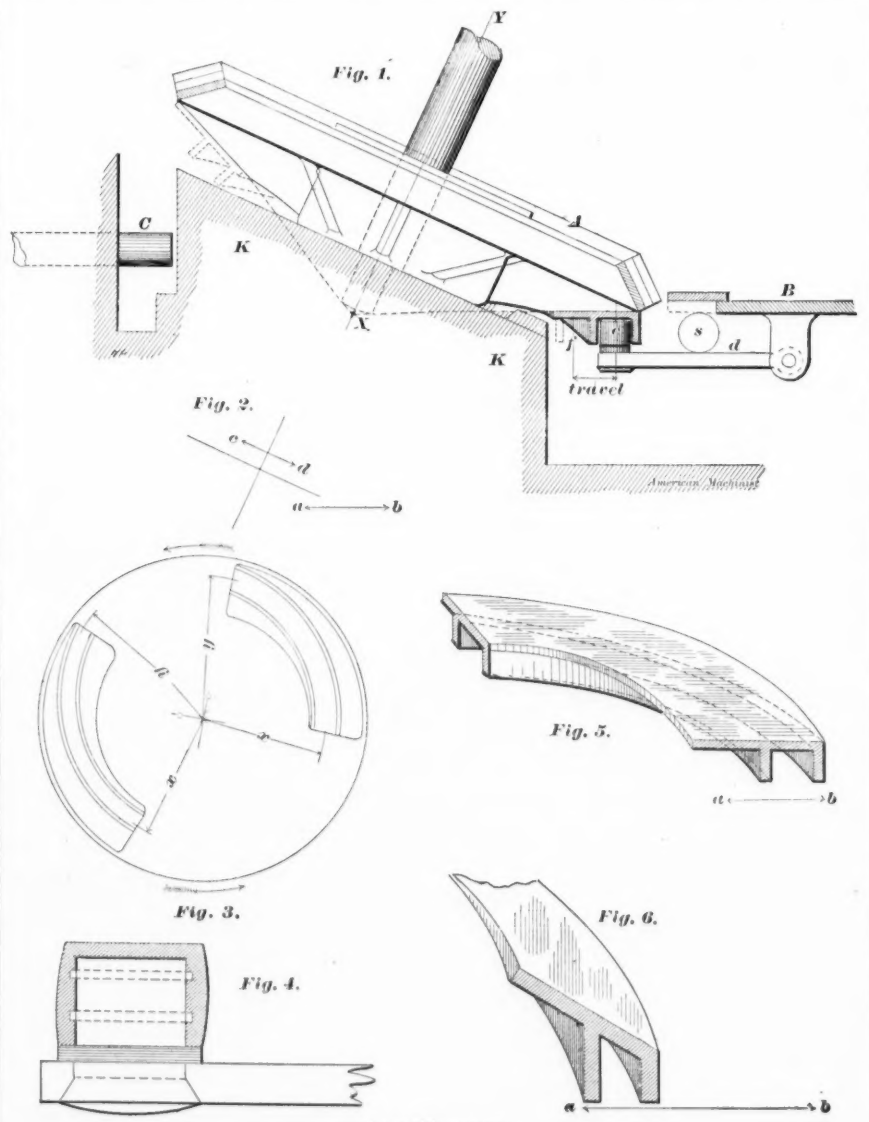
If, therefore, the metal could change in temperature as rapidly as the steam, then, on the admission of the volume necessary for the next stroke entering the cylinder at the higher initial pressure and temperature, and coming in contact with the cooler surfaces of the cylinder, cylinder head, etc., loss by condensation would result. And there is loss from condensation under the conditions as they are.

By the lesser number of expansions, which, of course, becomes admissible in the compound engine, this loss by condensation can be reduced to the minimum

In the year 1769 Watt discovered this loss due to the change of temperature in the cylinder, as caused by what was customary previous to that time, viz., that of injecting the cold water for condensing into the steam cylinder. This discovery led to the invention of a separate condenser, and also of the steam jacket. He said: "That vessel in which the powers of steam are to be employed to work the engine, which is called the cylinder in common fire engines, and which I call the steam vessel, must, during the whole time the engine is at work, be kept as hot as the steam which enters it." Again: "In those engines that are to be worked wholly or partially by condensation of steam, the steam is to be condensed in vessels distinct from the cylinders, though occasionally communicating with them. These vessels I call the condensers, and whilst the engines are working they ought to be kept as cool as the air in that neighborhood, by the application of water or other cool bodies."

Now the same reasoning can be used in connection with a high rate of expansion in a single cylinder. Therefore, if the rate in each cylinder can be reduced to say 3, and at the same time the total rate increased to 27 expansions, as in the triple-expansion engine, and this by the use of high-pressure steam of 150 pounds above the atmosphere, then we may expect to add materially to the economy of operation.

Several engines have of late been built upon the basis of this reasoning, and, notwithstanding the fact that they have not as yet been tested under the exact conditions as were at first contemplated, yet enough gain has been shown to prove the principle to be correct.



CAM MOTIONS.

The Southern Exposition at Raleigh, N. C., opens on October 1. Information in regard to it can be had by writing to F. B. Chilton, General Manager, Raleigh, N. C.

Cam Motions.

BY W. H. BOOTH.

There appears a decided tendency amongst mechanical men to work in grooves. When a certain end is sought in a piece of machinery half a dozen men will select perhaps as many different ways of attaining the end sought.

One man pins his faith to toothed wheels, and will use them as spurs or bevels to get almost any motion; another man works with pawls and ratchets, and a third with cranks. All this often arises from some particular bent of mind impressed, perhaps, by a special early training. My own mechanical weakness runs in the direction of cam motions. All my earliest practical mechanical experience was acquired amidst cotton machinery, and the engineering dependent thereon, and those who know what cotton machinery is will readily appreciate how cam motions became my weakness, for there are so many motions in the machinery of the textile trades which are attained by cams, with a certainty and precision practically impossible with any other mechanical arrangement, and wholly impossible in the same space. That the same ends could be attained by other mechanical means is not to be disputed, but it is certain that the complications would require a mathematical professor to work out what a very ordinary man can scheme to do with two pieces in a compact cam motion.

My earliest experience in steam engine valve gear, apart from the plain slide, was also of a cam actuated arrangement.

A year or two since there was a new machine to be constructed in which was one piece to be given a reciprocating motion, and there was apparently but one point from which motion could be given. The amount required was not above an inch or two.

A wheel *A*, Fig. 1, revolved slowly on an inclined spindle, and a shaft end *C* projected as shown, also revolving slowly. The platen *B* was the piece to be slowly reciprocated, and it was preferable that it should move to and fro either once or twice for each turn of the wheel *A*.

The amount of space for further mechanism was limited. No continuation of either shaft was possible; the space *K* was already filled up, and the available space for connecting *C* to *B* was very limited, and was past the ends of the projection *K*. Several attempted to solve the problem, but they one and all attempted it from the shaft *C*, my own idea being first based on cam motion from *C* with pull rods and bell cranks to *B*. As the final solution may prove of interest to some of the youngsters in the drawing office and pattern shops, I give it as it may serve also to suggest a solution in other cases.

The idea came to me full fledged exactly as it was carried out, and whilst walking home, after I was convinced of the at least undesirability of working from shaft *C*. What occurred to me was that the lost motion and spring of the pull rods from *C* and the ratchet gears was all to be avoided by a more direct drive from a nearer point, and the only nearer moving point there was was the lower part of the inclined wheel *A*, and before I had gone ten yards the idea was completed, viz., to fix a short stout arm *d* to the underside of *B*, and upon the end of this arm place a roller on a pin (I should say that one difficulty was the liability to dust and dry ground gritty matter getting to the machinery,) and place this roller so that it should be alternately pulled and pushed by cam plates fixed to the arms of the wheel *A*. A few minutes sufficed to lay the plan down on a tracing, and next day I took the sketch down to the draftsman, who, by the way, could not at first understand it, and vowed it was impossible to move *B* horizontally to and fro by means of a stiff projecting arm *d*, and any possible cam plates on *A*, but after a day's study and sketching he became converted, and I had the pleasure of seeing him swearing at the foreman pattern maker for being so dull as not to grasp the thing at once, and then

when it came to building up and cutting the pattern, the pattern maker had a go at the draftsman.

I had found that, by slightly cutting off the edges of the wheel arms, these cam plates could be fixed so that they would not touch anything as the wheel revolved.

The problem was to find the form of the plates such that, when attached to a wheel revolving in the plane *c d*, Fig. 2, they would move a friction roller to and fro along a path *a h*.

In vertical section the extreme positions of the cam roller center line are those shown as *e* and *f*, and it is to be noted that as each portion of the cam plate gets down to the longitudinal center line in which the roller moves, the working faces must be vertical. It is easy to see that were the friction roller a circular cutter revolving at the end of a reciprocating arm *d*, Fig. 1, it would cut out the cam path for itself as the wheel *A* revolved, but the difficulty was to set the thing out and make the pattern, which was all the more difficult because, as seen in plan, Fig. 3, the cam pieces spiraled in towards the center, each cam taking the roller at the position where the previous cam had left it, and leaving it at the opposite extremity of its short stroke.

The patterns when finished had not a straight line or a plane surface about them, for they had to bed to the back of a wheel which sloped at a different angle from the inclination of the plane of revolution, and to be of such dimensions that, as each part crossed the center line on which moved the roller, the cam cheeks should come down to this level. Though the motion was so exceedingly simple and effective, it seemed to me that a pattern maker who was able to set out and make such a pattern was fit for any difficult work. The roller and pin were of gun metal and steel, with two internal grooves for graphite lubrication, as in Fig. 4.

Fig. 3 gives no idea of the peculiarly twisted appearance of the cam plates. The bases for attachment to the wheel back were first got out as flat, but twisted plates, concentric with the wheel.

On these the cam plates were attached, also of course twisted, but further spirally extending across the base plates. Finally, the bases were cut away where superfluous. The bases were of course each portions of the superficies of a conical surface.

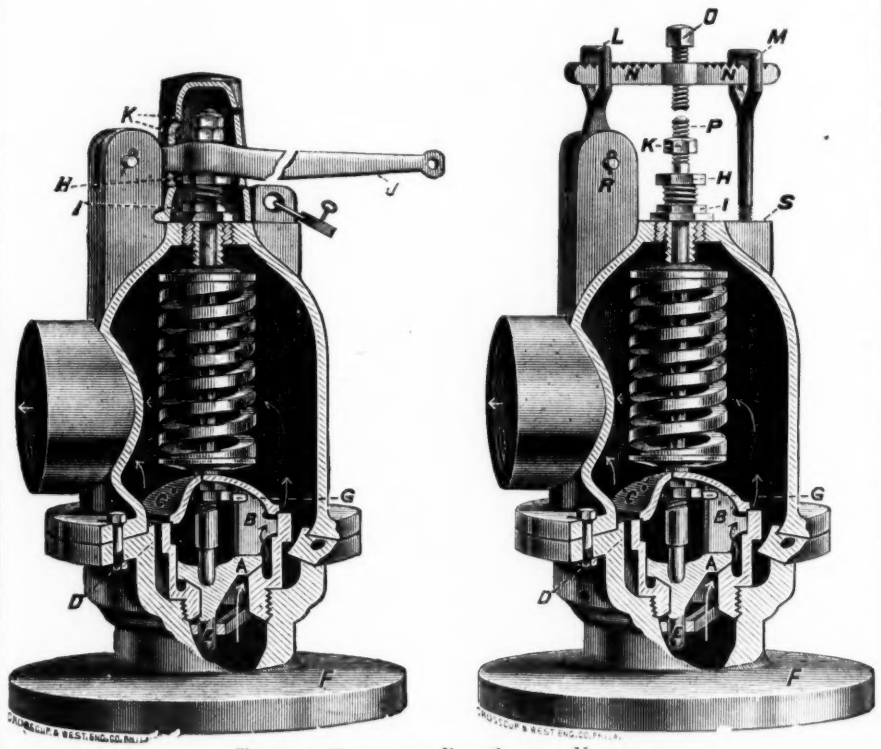
What made the matter difficult to design was the fact that a pipe *s* ran right across, as shown in Fig. 1, and that the solidly occupied space *K K* curtailed the range of the position of cam plates.

Of course in the actual machinery there was no actual solid *K K*, but there were pieces which were effectually solid so far as that they barred out any interference in the space shown as solid.

In Fig. 5 I have endeavored to give a sort of perspective view of one cam plate. In setting the plates out their connection with the wheel *A* should not be considered, but they must simply be treated as portions of a conical surface, the apex of the cone being at *X* and its center line *X Y*. The construction would have been further complicated if the arms to which the plates were attached could not have been dressed off the form shown, so as to be parallel on the longitudinal section with the direction of motion of the roller, as it would have involved the cam faces, *i. e.*, the vertical plates, being of unequal heights at every position on their spiral, as well as not square by their base plate, somewhat in fact as in Fig. 6. I suppose a pattern maker would scorn to do it, but it has often occurred to me that in such and similar cases of twisted work, a pattern such as shown here, Fig. 5, could very well be made perfectly flat and free from twist, and cast in lead or equally pliable alloy which could be bedded to the required conical or other surface, and finished true, and an iron pattern then cast from the lead for foundry use. Of necessity such a trick is like a fraud on the genuine pattern maker, and it was not our way of working. Still I think it could be satisfactorily done in the way named.

Testing Yoke for Pop Safety Valves.

We present herewith engravings showing an invention intended for the convenience of those who have boiler inspecting to do. It is made by J. E. Lonergan & Co., 211 Race street, Philadelphia, and is shown applied to the well-known pop safety valve made by them, though the device is applicable to any make of pop valve. The device is intended to prevent undue stress being applied to the valve spring during the application of the test pressure, and, using it, it is not necessary to disturb the adjustment of the valve. In applying the device it is only necessary to remove the cap and lever *J*, also the lock and the lug in which it engages, this lug being screwed into the case. In place of the lug, the eye-bolt *M* is put in, and in place of the lever *J*, the yoke *L*. The cross-bar *N*, provided with the set-screw *O*, is then put in place, and the set-screw turned down until it comes into contact with the stud *P*, and exerts sufficient pressure in connection with that of the spring to hold the valve to its seat. The end of the set-screw is hollowed to fit the end of the stud. The device is so made that it can be applied to marine or stationary valves from two to six inches nominal diameter. Boiler inspectors and engineers will no doubt appreciate the convenience of the Lonergan yoke or gag, as the need for something of the kind has been apparent.



TESTING YOKE FOR POP SAFETY VALVES.

The Institution of Naval Architects.

London *Engineering* has an interesting account of the meeting of this Institution, from which we make some extracts, as below:

WARSHIP CONSTRUCTION.

The first paper on the list was a contribution by Sir Nathaniel Barnaby, entitled, "Recent Progress in Warship Construction, as illustrated by the Models at the Royal Naval Exhibition." The author commenced by saying that the progress of naval construction in all its departments might be traced in the thirty-one volumes of the "Transactions of the Institution," and that not one ship remained in the Royal Navy of all those which existed thirty-one years before, when the Institution was founded. In 1860 one of the Admiralty naval architects referred to the "Warrior" and "Black Prince" as ships exceptional in point of size, and pointed out that, whilst there was nothing to prevent increase in the dimensions in the size of merchant vessels, the size of men-of-war was limited by certain considerations. Among these were mentioned the value of numbers of ships rather than concentrating the force in few ships, the probability that armor would be always perforable by the gun, and that the ram would come into use. The dimensions of the "Warrior" and "Black Prince" were 380 feet in length, and 9,000 tons displacement. "The Minotaur" was somewhat larger, but the length of 380 feet has never been exceeded in an ironclad ship in the navy, although the displacement has risen to 14,000 tons. The ships of the "Ramillies" class of to-day have the same length as the "Warrior," but three knots per hour higher speed, and an excess of displacement more than fifty per cent. The following comparison is of interest:

	"Warrior."	"Ramillies."
Length	380 ft.	380 ft.
Breadth	58 ft. 4 in.	75 ft.
Draught of water (extreme)	26 ft. 9 in.	27 ft. 6 in.
Displacement (tons)	9,210	14,150
Indicated horse-power	5,270	13,000
Speed (knots per hour)	14.4	17 5
Armor, maximum thickness	4½ in. iron	18 in. steel.
Coal endurance at 10 knots speed	1,210 knots	5,000 knots.
Number of guns	32	14
Weight of broadside	1,918 lb.	5,500 lb.
Speed per hour of fastest boat carried	8 knots	18 knots.
First cost of hull and propelling engines.	£357,000	£875,000.

Sir Nathaniel next proceeded to comment on the advances made in marine engineering, and bore testimony to the debt the naval architect owed to the engineer. The first Council of the Institution consisted of 28 professional members, not one being an engineer. At the present time there are 24 professional members, 11 being marine engineers. The author is under great apprehension that the naval architect will die out, excepting for those brought up in the naval service. The number of private students at the Royal Naval College, Greenwich, has been but two during the last session; and "as to apprenticeship to the trade of shipwright, it may safely be stated that outside the Royal Dockyards the shipwright apprentice has ceased to exist." An experienced employer of shipbuilding labor had said to Sir Nathaniel: "It is no longer the practice with us, nor, I believe, with other firms, to take apprentices in any trade. Boys are employed, but without indentures, and with less regularity of employment. I think this is to be regretted, as they cannot obtain so good a training or knowledge of their trade."

The paper pointed out that in 1870 Mr. Childers proposed to keep up a force of from 50 to 60 ironclads as being ample. In 1873 Mr. Goschen thought we were so strong in ironclads that we could afford to proceed with calmness. In 1874, Mr. Ward Hunt said that our force of ironclads was 55, of which 41 were seagoing; 40 to 50 ironclads, the paper says, by no means satisfies our statesmen of to-day. Lord Brassey laid down, in his paper of last March, as a five years' programme to be maintained after the completion of the Hamilton programme, 10 battle ships, six armored coast defense vessels, six armored rams, 40 cruisers of the first class, 30 lookout ships, and 50 torpedo gun vessels. The 40 cruisers of the first class would be all armored or protected, but omitting these, the proposal would give us a force of ironclads twice as powerful as that regarded as ample by Mr. Childers and Mr. Goschen.

The discussion of Sir Nathaniel Barnaby's paper was opened by Admiral Sir Edward Freemantle, who said he was of opinion that, in spite of what had been put forward in the paper, there was no finality in the matter of length with regard to warships, and he thought that length would go on increasing. An argument in favor of short ships was that they would turn more easily, but now the big vessels were fitted with double screws the maneuvering powers of the rudder could be supplemented in this way. The question of many ships of smaller size as against a fewer number of large size was one of great importance, but he was of opinion that it was proved by history that the big ship principle was the right one. With regard to the change of opinion as to what was considered the necessities of the present day with regard to the navy, as compared to those of past times, he was of opinion that a great part of the change was due to ministers now having a higher sense of their responsibilities. They recognized now that there was an enormous commerce to protect. Beyond this, however, our needs had increased from the fact that other nations had become more powerful on the sea. Not long ago the German navy hardly existed, and within quite recent times the Italians had made enormous efforts to improve their fleet, so that now it included some of the most perfect ships of war existing. These, and other circumstances, had changed our needs.

Lord Brassey was the next speaker. He said that the question of whether big or small warships should be built must not be considered in too narrow a spirit. A complete navy required various types, and some of the ships must necessarily be of great size and enormous cost. Still he thought that the argument in favor of small ships was a very strong one, and taking cost as a basis, it seemed to him that two ships of half a million each might be better than one costing a million. There were two rams against one, and there were two captains against one. The officer fighting the ship must necessarily be exposed to great danger, and with the two ships there was the chance, if one captain was killed, of the second in the other vessel being able to carry on the fight. The speaker was also of opinion that the change of opinion in the navy on the question of armament also militated in favor of smaller and more numerous ships. With increased dimensions thicker armor could be carried, but it was a question what value was to be attached to an increase in thickness, from say 12 inches to 20 inches, seeing that it was impossible to give plates that could not be penetrated. The policy of limiting dimensions was a very difficult one to carry out. He would give an instance which would well illustrate the fact. When Lord Brassey was on the Board of Admiralty it was determined to build two ships each with a single turret, in order to have a ship of smaller size and less expense than would be necessary with two turrets. When the designs were put forward it was pointed out that, abroad, ships were in progress with thicker armor and bigger guns. The question the board had to settle was, whether it should be permitted that the British navy should build battle ships inferior to those possessed by another power in the respects named. The answer naturally was "No"; and the consequence was that the two ships which were designed for single turrets in order to save money grew into the "Victoria" and "Sans Pareil," the two most costly and powerful ships of their time; they grew to this, as other nations had thick armor and big guns. Lord Brassey was of opinion that these single-turret ships were not of a felicitous type. He would turn them end for end, as they were high where they should be low, and low where they should be high. The difference of

opinion with various Boards of Admiralty, to which the author had referred, with regard to the strength of navy desirable, was, in Lord Brassey's opinion, easily to be accounted for, and was quite natural. Our navy was designed to meet other navies, and if foreign powers increased their fleets we must respond.

The Premium Plan of Paying for Labor.

In our issue of June 18 we published a paper with the above title, read by Mr. F. A. Halsey at the Providence Meeting of Mechanical Engineers, and a little later we published considerable of the discussion brought out by the presentation of this paper. Through the courtesy of the author we are able to present, this week, his complete reply to this discussion, which we assume is as it will go into the Transactions.

AUTHOR'S REPLY.

It is all very well to say, as Mr. Hawkins and others have done, that the true solution of the wages problem is for men to deal justly with one another, which in this connection means for the employe to exert himself to the utmost, and for the employer to pay as high wages as he can afford. Unfortunately, however, this is not in human nature, and whatever the millennium may bring, the problem before the employers of to-day is to deal with human nature as it is. It is a truism that the average man will not work for others as for himself, and the average employer desires to get his product as cheaply as possible. This may seem culpable to Mr. Hawkins, but to the writer it seems natural, just and proper. At all events it is inevitable, and it is the purpose of the premium plan to provide for and make use of these features of human nature by giving the employe an opportunity to work in a measure for himself, and by giving the employer the assurance of a more than proportionate increase of product from a given increase of wages.

Mr. Hawkins' objection that the premium plan involves the "unexistable" condition of a profit of twenty-five per cent., and that the manufacturer has no right to such a profit, seems to me irrelevant. Such arguments do not prevail against facts, and while, of course, it is not to be expected that the system will produce a general increase of output of one hundred per cent.,* it is nevertheless true that, in individual operations, that figure has been often exceeded, and that, too, when such foremanship talent as was available had not discovered anything wrong with previous records.

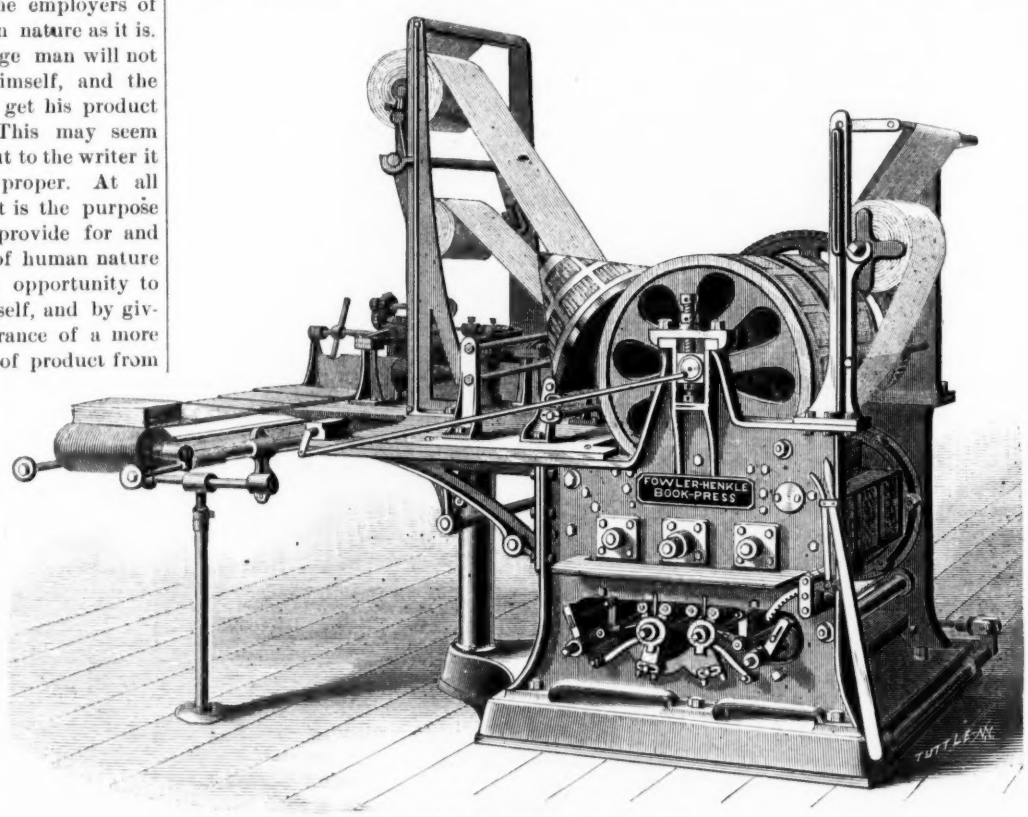
Mr. Hawkins' third objection, that rival concerns would spring up, and by avoiding the premiums produce the work that much cheaper, is based upon the assumption that the premiums are a charge upon production, *i. e.*, that the same production can be had without as with them. This is the kernel of the question, and here I believe Mr. Hawkins to be wholly wrong. He here, as indeed all along, confounds plans based upon the profit-sharing principle, viz., the division of a percentage of the profits among the employes, in the general faith that the promise of such division will buy their good will, and thereby lead them to increase their product at least enough to make up the amount divided among them, *but which amount is to be divided, whether the increase really takes place or not*—with the present system, in which the premiums are paid only in case of actual increase. With the first system the increase must take place as the cost of production is raised, but with the second system this is impossible. There could be no better place to try the question to a conclusion than such a shop as Mr. Hawkins proposes, where the day's work method is employed in the most enlightened manner. Mr. Hawkins may find a few men (I have never found one) who will produce as much on the day's wages method as when offered the inducement of the premium plan, but that is not and never will be the case with an entire force; and if a single man of the force is susceptible to such inducement, the plan applied to him will cheapen the product. *If it does not reduce the cost there will be no premiums to pay.* The fact is, that the average employer, foreman or workman, who has seen machine tools operated only on the day's work system, does not know what they are capable of producing, and to those who have seen them worked under systems analogous to the one proposed, the claim that as good results can be obtained under day's work methods seems absurd.

Turning now to Mr. Davis' remarks, I have no shadow of doubt that his workmen could, and to one possessing their confidence would draw a very different picture from his as to the "automatic" feature of piece-work. Mr. Davis seems to have succeeded in getting his men to compete with one another. Few have succeeded in this, the usual reduction in the piece prices being brought about by a direct cut by the employer. However, the results are the same. Each workman knows that if he push his earnings above a more or less clearly defined limit, some other workman will underbid him, and he would be foolish indeed were he too active. When men know, as under piece-work all do know, that their earnings will not be allowed to exceed a certain limit, it is idle to expect them to exert themselves to pass that limit, and right here is the essential difference between the piece-work plan and the one under discussion, which some seem unable to see. The piece-work plan necessarily sets such a limit, while the present one does not. As to the system furnishing a mere stepping-stone to the piece-work plan, the case is exactly analogous to a mathematical limit. When improvement can go no farther, the system may be turned into piece-work, but that, like a mathematical limit, is a condition that we forever approach, but can never reach.

As the system proposed has excited considerable interest, I add a few practical hints to any who may feel disposed to give it a trial. The first of these is a caution against expecting the workmen to receive it with any enthusiasm. On the contrary, they will in most cases look upon it as piece-work in disguise, and that system is so excessively and justly unpopular that they will at first regard the present plan with suspicion. A little patience on the part of the employer and a little experience on the part of the employe will correct this as the workmen find that the premiums are not a myth.

It has been pointed out in the body of the paper that the system enables the employer to deal liberally with his men. At the same time there are two directions which this liberality can take; one method—and the wrong one—is to take the best record obtainable as a base, and then offer a liberal premium for its reduction. No force can be composed entirely of "stars," and if the above plan is followed it will be but a question of a short time when an inferior man will be put upon that job, who will soon find that he cannot equal the base rate, and he will cease trying. At the same time a really superior man on the same job might push his earnings so high in consequence of the large premium as to tempt the employer to the fatal step of cutting down the premiums. To meet this condition I have adopted the settled policy of being liberal with the time rate rather than the premium rate, thus giving all a chance, and keeping the premiums within bounds. Whatever may be the final policy in this particular, the system should be at least inaugurated with moderate premiums, since, if the experimental premiums are made too low, no one can object to their being raised, whereas, should they be too high, it is another matter to lower them. In this connection the table given in the body of the paper was intended solely as an illustration of the principle of the system. As a matter of fact, a premium rate such as is there given would be altogether too high for the ordinary run of light machine shop work, while for other and more laborious work it might be altogether too low.

Finally, it is but just to himself for the author to add that the method has been in no way suggested by Mr. Towne's excellent gain-sharing system. In point of fact the present plan was clearly formulated before the publication of Mr. Towne's paper. Its publication has been deferred in order that it might first receive practical trial, and be presented with a corresponding measure of assurance. It has now been tried in three establishments, and in each case with results such as have been described.



THE FOWLER-HENKLE BOOK PRESS.

Messrs. R. D. Wood & Co., of Philadelphia, have taken a contract to build for the heat, light and power department of Sibley College and the Cornell University, a pair of "parallel flow" turbines, of the Jonval type, as designed by Mr. Emile Geyelin, the distinguished expert hydraulic engineer, of a total of 175 horse-power, and, in high stages of Fall Creek, perhaps 200 horse-power, for the purpose of driving the shops, and the experimental and lighting dynamos of the college and the university. The E. P. Allis Co., of Milwaukee, are building, and have well in hand, a triple-expansion engine of similar power, for experimental and other purposes, designed in such manner as to permit any desired changes of arrangement, power, steam distribution, for use in investigation, or to be employed as a reserve with the water-power. When these new machines are in place, next fall, the college will possess some 600 horse-power of boilers, nearly 250 horse-power in water wheels, including the existing turbine, and about 300 horse-power in steam engines, mainly arranged for purposes of experiment in the mechanical and electrical laboratories of the college.

The Fowler-Henkle Printing Presses.

At 213 Centre street, this city, may now be seen in operation some printing presses, which are illustrated on this and page 5, which embody many features of novelty in printing press construction.

The classes of work for which the presses are intended are indicated on the engravings, the construction of the two presses being essentially different. In both presses, however, a prime object is to produce a press adapted to fill a position midway between the rotary press and the "stop cylinder," or "two-revolution" press.

In order to make this clear, it may be advisable to explain that the rotary presses are those upon which the large editions of the daily papers are printed, in which the main consideration is the ability to print many thousands of copies an hour, but where the work done is not expected to approach, in quality, that of book-work, or such work as is done on the AMERICAN MACHINIST. Such work is done on what are known as "stop-cylinder" or "two revolution" presses, using flat plates from which to print, the speed being limited by the fact that there are heavy reciprocating parts in the machine which cannot be moved above a certain speed.

In these new presses, flat plates, or forms, are used for printing, and yet the motions are not reciprocating, but continuous rotary motions, admitting of comparatively high speeds, and yet doing work comparable with book-work done on the ordinary book press.

In the press illustrated by the first engraving, which is intended especially for book-work, there is an impression cylinder of the ordinary form, which is above the center of the main frame of the press. Beneath this there are two tracks, one attached to each side of the frame, the form of these tracks being oblong, with circular ends. Passing through from one side of the frame to the other, within these tracks, there are three shafts, the ends of which are seen projecting through the frame just below the impression cylinder. The two outer shafts are in the respective centers of the rounded ends of the tracks spoken of, and on all three of the shafts, which are driven at the same uniform speed, there are gears which engage with blocks adapted to pass around through the tracks continuously in one direction, passing under, and in contact with, the impression cylinder when above the central shaft, and over the inking rolls when below it. These blocks carry the plates, or forms, from which the printing is done, and though they are not linked or directly connected together in any way, yet they maintain their proper positions with respect to each other at all times by means of a new driving device. Near each end of these blocks, and on their under surfaces, there is a short section of toothed rack, which is curved in such a way as to make it practically a sector of an internal gear. These racks engage with gear wheels that are on the two outer shafts, which thus carry them around the circular ends of the tracks, the blocks being guided by rollers which run in the tracks at each end of the blocks.

*The table given in the paper is merely an illustration to explain the working of the system. There is nothing about it, or in connection with it, to justify Mr. Hawkins implying me to represent the last line of the table as an average result to be expected from the system.

At the side of these curved racks or internal gear sectors there are other racks, which are straight, and these latter engage with gear wheels which are on the central shaft, and which thus move the blocks over the straight portion of the tracks, the change from driving by one set of gears and racks to the other being made by teeth which overlap, so to speak; *i. e.*, about three teeth of the straight racks are engaged with the gears on the central shaft before those of the circular racks are disengaged with the gears on the outer shafts. Thus the motion is continuous, and as smooth at high speeds as could be desired.

In this press the cylinder and blocks in which the plates are locked are double the width of the paper, the plates on one side printing one side of the paper, while those on the other side print the reverse side, or do what is technically called the "perfecting."

Supposing, for example, that a book or section of a book containing thirty-two pages is to be printed. The paper, which is of a width to print but two pages wide, is fed from an endless web, or roll, placed at the rear of the impression cylinder, from which roll the paper, after passing through the necessary "tension rolls," passes beneath the impression cylinder and on the left-hand side of the press, and, when the machine has made one revolution, has received the impress of the first sixteen pages of the "signature," or section; thence it passes over a turning device or "reverser," by which it is turned over and led back over the impression cylinder, beneath which it now re-enters on the right-hand side of the press, and parallel with the first side, where it receives the impression of the last sixteen or "perfecting" pages of the "signature," from whence the now printed and perfected sheet passes forward between the knives of a revolving cutter, which separate the web into sheets, which are deftly inserted, one within the other, until the eight sheets completing the "signature" have been collated, when the now completed "signature" is shot forward into the packer, to be at leisure removed by the attendant.

What is called an "offset" web goes with the paper at its second passage under the cylinder, this web being of heavy manila paper, which is automatically unwound from one roll, returned and re-wound upon a roll immediately beneath it, this lower roll being driven by means of a belt and pulley, which are connected to it by a sliding clutch. The two rolls are mounted in a swinging frame, so that when the paper is passed through one way the frame is swung around half way, so as to bring the other roll in connection with the clutch when the paper is passed through again, but the other side up, so that both sides of it are used equally. Special attention has been given also to the matter of ink distribution, and the printed matter comes from the press so dry that it can be immediately rubbed over by the hand without danger of smutting or "offset." This is accomplished by the use of only four form rollers taking ink from two trains of rollers supplied from two reservoirs or fountains. The rolls are capable of such adjustment as to produce the results named above. The register of the printing and folding mechanism seems to be very near absolute perfection, and is at least all that can be reasonably asked. It is easily possible with this press to deliver two to six thousand completed signatures of thirty-two pages each per hour, or double that number of sixteen-page signatures, and they are delivered in such shape as to require no further manipulation before going to the binder.

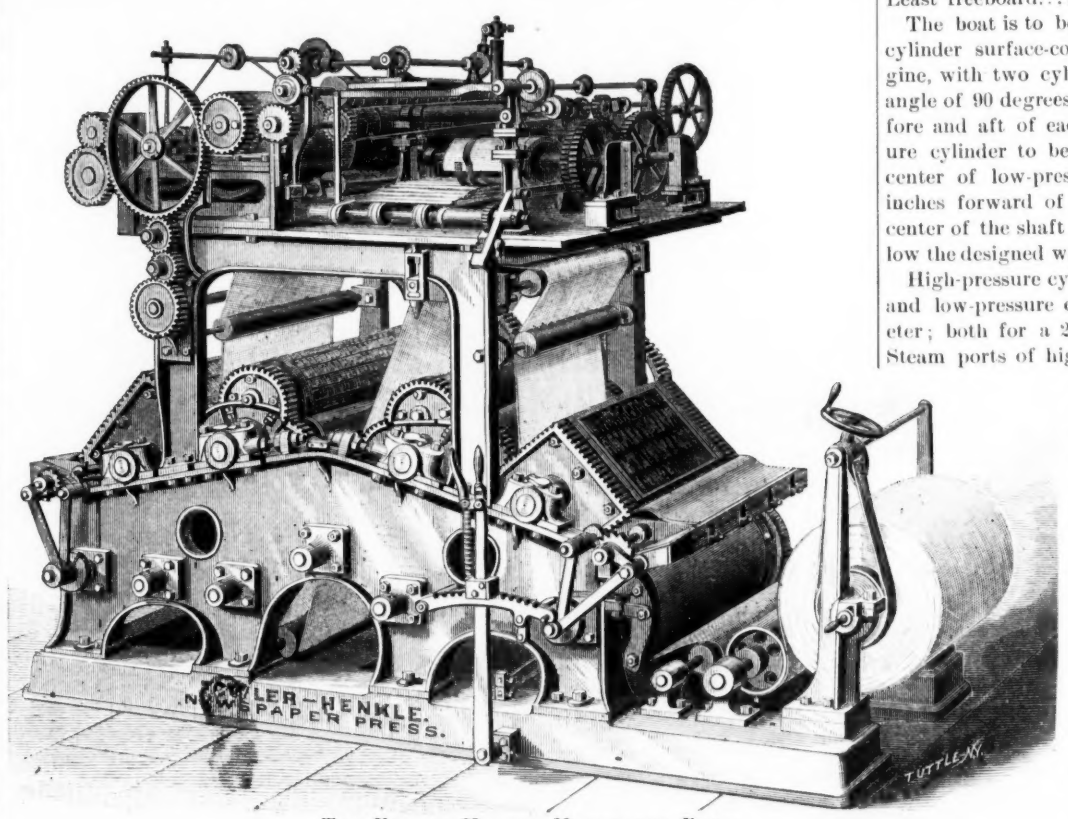
In the newspaper press (shown in the engraving on this page) an essentially different construction is employed, by which flat plates or forms of sufficient size for the pages of a newspaper can be employed, and yet be used on a rotary press. The forms are placed on the four sides of a cube which revolves upon a central shaft, the same as a cylinder, one of these cubes being seen at each side of the press. Near each end of the cubes there are gears, which, instead of being round, are square, being in reality four sections of straight-toothed rack cut upon the four sides of a square blank. The faces of the several forms lie in the plane which is coincident with the pitch line of these racks. Just behind the cubes there are what are equivalent to impression cylinders, except that these, instead of being real cylinders, are of such form that they roll with the cubes, the surfaces being at all times in contact, and at each end of these cylinders there are gears composed of four lobes of such form that their pitch lines coincide with those of the square gears, the surfaces of the rolls also coinciding with the pitch lines of the gears.

The web passes between the two as they revolve, and is printed first on one side and then on the other by the cylinder on the opposite side of the machine, from which it passes to the folding and cutting mechanism at the top.

The inking rolls are applied to the forms by means of a device which embodies the same principle as that of the gears already described, but in a somewhat different form.

The speed of this press is about the same as that of the ordinary rotary, and it is simple, compact, requires no pit, nor stereotyping, nor wetting and re-winding machinery, since it uses its paper dry.

It also affords every facility for making changes in the forms called for by news coming in late.



THE FOWLER-HENKLE NEWSPAPER PRESS.

We expect to give further attention to some of the special features of these presses in a future issue. They are made by the American Printing Press Company, 213 Centre street, New York.

Too Much Knowledge.

The foreman of a room in one of the largest manufacturing establishments in the country told a friend recently the circumstances of his first going to work there, and the brief story contains a moral which it would be well for many a lad starting out in life to lay to heart. He was sent to the foreman of the factory by a friend who was anxious to get him into the employ of the company, and the following conversation took place:

"Well," the foreman said, "I understand you want to come here to work. What do you know about machines?"

"Nothing," the other answered.

"Nothing!" echoed the foreman, in surprise. "You do not mean to say that you never saw a machine, I suppose?"

"I literally never saw a machine work in my life," was the reply, "except a locomotive."

"Where did you come from?"

"Cape Cod."

"Hum!" the foreman remarked, studying the face before him. "I came from the Cape myself. Do you suppose that there is anything in our business that you will not know all about in six months, if you come here to work?"

The Cape Cod man was puzzled how to answer, and contented himself with saying that he was sure he could not tell.

"The truth is," the foreman explained, "we can get plenty of men, but by the time they have been here six months or a year they know so much that we have to send them away. They know a vast deal more than we men who have been here twenty years, and they are mostly willing to tell us all they know, too.

"Now if you think there are things that you cannot learn in a week or two, we should like to hire you, but if you are one of the abominably wise kind, you had better move along and give us a chance to find somebody who doesn't know quite so much."
—*Youth's Companion.*

The United States is greatly behind most European countries in the use of cranes, thus reversing the conditions obtaining in the case of other kinds of labor-saving machinery, the use of which, as a rule, is even greater here than there. This fact is the more surprising, since the price of unskilled labor, which is the kind economized by the use of cranes, is higher relatively in this country than in Europe. These facts indicate large opportunity for increased economy where crude manual processes can be replaced by the use of cranes.—*Hoisting.*

The American Railway Master Mechanics Association have secured four scholarships in the Stevens Institute of Technology, and Secretary Sinclair has issued a circular setting forth the requirements. In it he says:

Candidates must be the sons of members or of honorary members of this association in good standing, or the sons of deceased members who died in good standing. They must also have worked for at least one year in a recognized machine shop, and they are required to take the course of mechanical engineering. The rules of the school require applicants for admission to be over seventeen years of age.

The circular gives information as to the examination the applicant must submit to, and other things of interest. Any intending applicants should address, without delay, the secretary at 140 Nassau street, New York.

It is noticeable that, while the speed of various machines or instruments for accomplishing various desirable things is being continually increased, that of horses has remained at a standstill for some years past, and it is believed by some competent men has about reached its highest development. The speed of bicycles has now almost reached that of the trotting record, and is being continually increased, so that it bids fair to surpass the horse. Locomotives make faster time continually, and do it with heavier trains, while on the water the transatlantic record is being constantly improved, with promise of still further improvement.

Iron Tugboat.

(*For Engravings, see page* 6.)

The accompanying illustrations show the general outline of an iron tugboat, and the general arrangement of its machinery. Negotiations for its construction are now pending, and it will probably be in active service in the near future. We believe the design to be a good one, and the following data, in connection with the illustrations, will be useful to some of our readers as matter of reference in designing similar boats.

The general dimensions of the hull are:

Length over all	118	feet	0	inches.
Length on water line	111	"	4	"
Extreme breadth of beam	22	"	3	"
Depth of hold amidships	11	"	6	"
Load draught of water aft.	10	"	3	"
Least freeboard	3	"	7	"

The boat is to be driven by an inverted cylinder surface-condensing compound engine, with two cylinders and cranks at an angle of 90 degrees. The cylinders to stand fore and aft of each other, the high-pressure cylinder to be the forward one. The center of low-pressure cylinder to be 12 inches forward of frame No. 41, and the center of the shaft to be 4 feet 7 inches below the designed water line on frame No. 41.

High-pressure cylinder 20 inches diameter, and low-pressure cylinder 40 inches diameter; both for a 26 inch stroke of piston. Steam ports of high-pressure cylinder not to be less than 24 square inches, and exhaust not less than 48 square inches; the low-pressure cylinder is to have double steam ports having a combined area of 102 square inches, and an exhaust area of 136 square inches. The lower ends of the cylinders to be fitted with a small bonnet with stuffing-box and gland, both bushed with composition; also a brass drain valve 1 inch diameter with copper pipes. Bed-plate is to be of cast-iron in one piece, composed of two fore-and-aft box girders 16 inches square, and three transverse box girders 10 inches wide and 16 inches deep. Fore-and-aft girders to have open bottoms, and transverse girders to be shaped to receive pillow blocks, etc. All necessary flanges, bosses and lugs for condenser, air-pump, etc., to be cast on, and all surfaces for flanges and connections to be planed. A light cast-iron or wrought-iron pan to be fitted under each crank to receive oil and drip from journals.

The main frame for carrying the cylinders on port side will be the surface condenser; cast-iron frames above having flanges and through bolts at cylinders and condenser, and crosshead guides, 8-inch face, cast on to the inside. On starboard side will be two rectangular cast-iron box columns 9 by 10 inches at cylinders, and 14 by 14 inches at bed-plate; thickness of metal about $\frac{3}{4}$ inch. Crosshead guides with 8-inch face, to be cast on. Distance between crosshead guides athwartships to be 18 inches, batter of columns 3 inches per foot. Columns to have suitable flanges at cylinders and bed-plate, and to be fastened with through bolts.

Steam chests to be cast separate, fitted with faced joints, and well bolted to cylinders. The high-pressure steam chest is to be fitted with a screw valve $2\frac{1}{2}$ inches diameter, for a pass-over valve, with copper pipes, and all necessary fittings and connec-

tions. Valve, seat and stem of composition. Each steam chest is to be fitted with a 1-inch relief valve of composition, with copper connection to condenser. A relief valve, set at 45 pounds, is to be fitted on low-pressure steam chest.

Slide valves to be of the ordinary D form, made of cast-iron of as different texture from the iron of the seats as possible, and scraped to a tight bearing surface. A "Meyer" cut-off valve is to be fitted on back of high-pressure valve, worked by a separate eccentric, with right and left-hand screws for adjusting the point of cut-off. Suitable hand-wheel for operating, and an indicator plate, graduated to show the point of cut, is to be provided.

Intermediate receiver is to be of copper pipe 10 inches diameter, and of sufficient thickness to stand a working pressure of 50 pounds; to have composition flanges, faced, with backing flange to which the pipe is to be riveted and brazed.

The valves are to be worked by a "Stephenson" link motion; the links to be of the "double bar" pattern, with a throw of about 15 inches; to be made of machinery steel, 2¾ inches deep and 1¼ inch face. Blocks to be of steel, each with four brass gibs of sufficient size for good working. Main eccentrics to have 2½ inch face, and cut-off eccentric 2 inch face. Straps to be of close-grained cast-iron, well babbitted and ribbed. Eccentric rods to be made of machinery steel; the ends connecting with straps to have T heads forged on, and to bolt to straps with steel turned bolts, fitted with check nuts, the link ends of rods to be forked, and fitted with adjustable brasses for taking up wear without altering length of rods. Valve stems to be of mild steel 1¾ inch diameter for low-pressure cylinder, and 1½ inch diameter for high-pressure cylinder, and stem of cut-off valve to be 1¼ inch diameter.

Pistons to be of cast-iron, double shell, properly ribbed, with cast-iron follower fastened with steel bolts screwed into brass nuts. Packing rings to be of cast-iron, in two thicknesses, and set out with steel springs. Piston rods to be of mild steel 3½ inches diameter, turned with $\frac{1}{16}$ inch shoulder on each end, and with a slight taper to bearings in pistons and crossheads, and to be secured with steel nuts. Each crosshead is to have two journals 3¾ inches diameter and 4¼ inches long. On each side of crosshead there will be a brass slipper fitted with taper liner and suitable nut and bolt for making adjustments for wear. The wearing surface of the brass slippers not to be less than 96 square inches each.

Connecting rods to be of the best hammered iron; forked at crosshead end, and a T at crank-pin end; length about 5 feet 9 inches, and furnished with composition boxes at each end, lined with "magnolia metal," and fitted with wrought iron cap plates, and turned steel bolts with nuts. Rods to be 3½ inches diameter in neck at forked end, 3¾ inches diameter in neck at crank-pin end, and 4⅛ inches diameter at center. The two bolts at crank-pin end to have each a diameter of 2⅛ inches at root of thread; and the four bolts at crosshead end each to have a diameter of 1½ inch at root of thread. Bolts fitted with proper steady pins to prevent turning, and nuts recessed into rods about one-half their depth, and a suitable screw fitted to keep them from turning.

Crank-shaft pillow blocks to be fitted with composition boxes babbitted. Forward journal 10 inches long; intermediate journal 18 inches long, and after journal 15 inches long, all to be 8 inches diameter. Caps to be recessed for boxes, and held in position by eight steel bolts 2½ inches diameter; two in the forward bearing, four in the middle, and two in after bearing; and spaced about 13½ to 14 inches between centers.

Crank-shaft to be forged in one piece. Crank arms to be about 4½ inches in thickness and 9 inches in width each. Crank-pin journals 7½ inches long and 8 inches diameter. Line shaft to be made of wrought-iron in two lengths, 7½ inches diameter, to be covered with composition at stuffing-box and stern bearing, to be about ⅝ inch thick, cast on. Couplings to be in pairs of cast-iron disks with concentric projections ¼ inch deep and about 3½ inches diameter, one disk to fit in corresponding recess in the other; and a steel cross key; disks to be fastened together with six 2½-inch turned bolts.

The bearing surfaces in thrust bearing to have a maximum pressure of not more than 40 pounds per square inch. Caps to be well secured to blocks to receive thrust, and to be fitted with a proper oil reservoir for lubrication. Counterbalance wheel to be of cast-iron, well fastened to after end of crank-shaft; to be fitted with suitable notches so as to serve as a "pry-off" wheel when required, and also to serve as one disk of coupling.

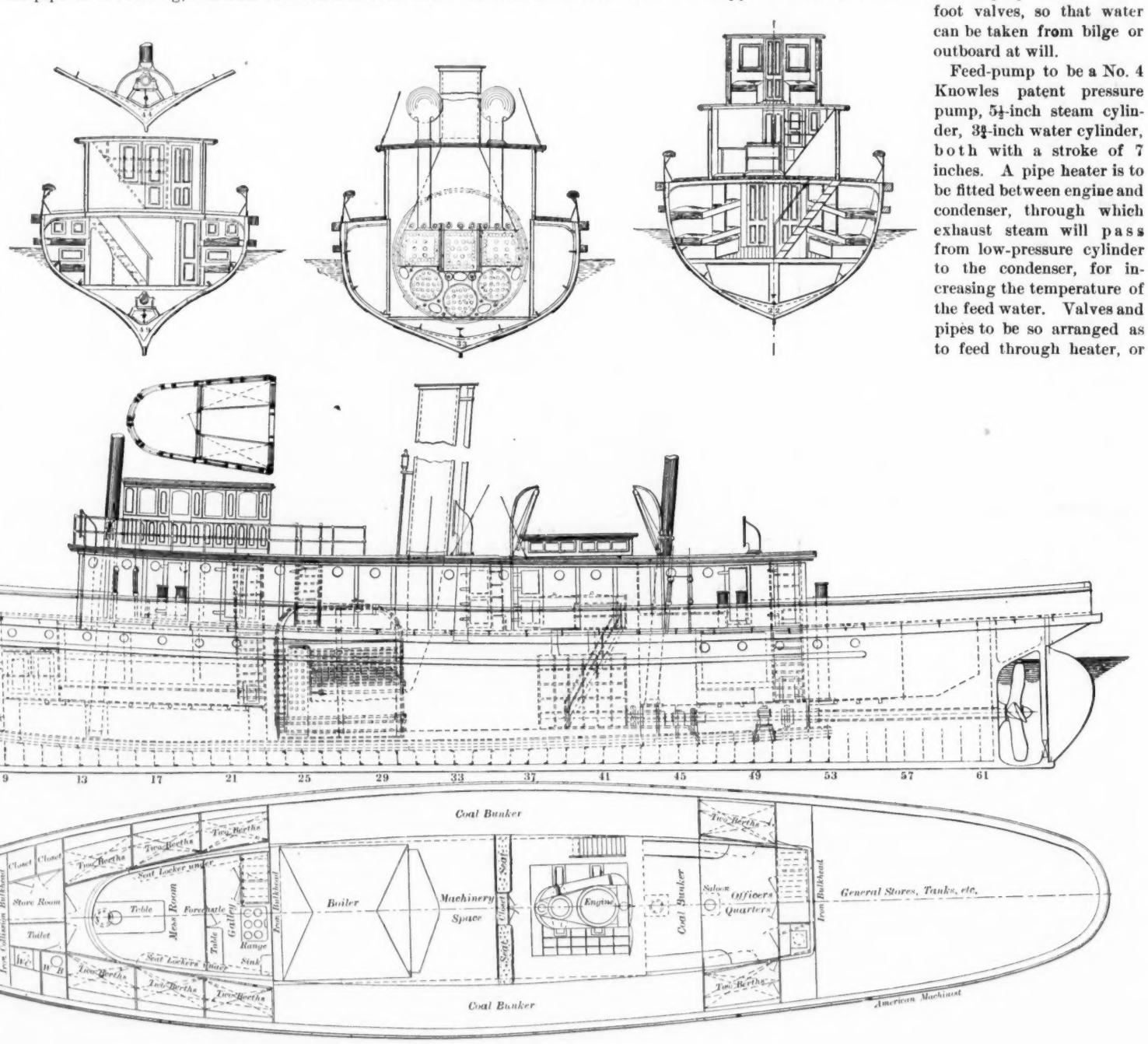
Surface condenser to have a cooling surface of 1,000 square feet, measured on outside of tubes; cast-iron shell 1 inch thick, and to have a length of about 8 feet 1 inch between flanges. Midway between the tube heads, longitudinally, a cast-iron plate will be fitted and secured to shell to support the tubes and keep them from chattering. Parallel to and about 4 inches above the upper row of tubes will be a baffle plate, perforated and secured to shell. Tube heads to be of composition not less than 1¼ inch thick, and bolted in place with yellow metal or composition standing bolts. Tubes to have cotton packing compressed with suitable glands or followers. Tubes to be ⅝ inch in diameter, tinned inside and out, laid in horizontal layers or tiers, and arranged in two nests or sets, so that the refrigerating water will pass twice through tubes. A suitable brass cup or valve is to be fitted for introducing soda to the condenser.

Air-pump to be vertical, single acting, 19 inches diameter and 12 inches stroke, worked from low-pressure crosshead by means of suitable levers and links. Pump barrel liner, plunger, valve seats, bolts and guards to be of composition; the rod to be of steel encased in composition. Valve seats to be of grating form and valves of pure rubber. Hot well to be cast on air-pump, concentric with body of pump, and fitted with feed-water connection and outboard delivery. The feed water to be led to a galvanized iron receiving tank from which the feed pump will draw its supply. Receiving tank to hold not less than 500 gallons, and to be fitted with approved filter for separating oil and grease from water. The outboard delivery pipe to be of copper about 9½ inches diameter, No. 8 wire gauge in thickness, and fitted with a 10-inch poppet valve, with composition seat and stem.

The circulating pump is to have a capacity of not less than 600 gallons per minute at ordinary speed, with suitable size steam cylinder and direct connection. Delivery pipe to be of copper, No. 8 wire gauge, with valve, etc., same as outboard delivery of air-pump. Suction pipe to be 8 inches diameter, with branch and proper shut-off and foot valves, so that water can be taken from bilge or outboard at will.

Feed-pump to be a No. 4 Knowles patent pressure pump, 5½-inch steam cylinder, 3¾-inch water cylinder, both with a stroke of 7 inches. A pipe heater is to be fitted between engine and condenser, through which exhaust steam will pass from low-pressure cylinder to the condenser, for increasing the temperature of the feed water. Valves and pipes to be so arranged as to feed through heater, or outside in case of necessity. There will also be fitted one No. 7 Korting universal injector, with connections to receiving tank and fresh water tank. A bilge ejector is to be furnished; the discharge nozzle is to be 5 inches diameter, with proper connections for siphoning water from any compartment at will. Propeller wheel is to be of cast-iron, four bladed, 9 feet diameter, and fitted on shaft with fore-and-aft key, and a large cap outside with keeper.

Boiler to be of the "Scotch" type, 12 feet 6 inches in diameter, 12 feet long. To be made of Siemens-Martin steel. It is to have three Fox's patent corrugated furnaces 36 inches clear inside diameter, and 8 feet 11⅝ inches long. American lap-welded boiler tubes, 248 in number, 3 inches diameter, 8 feet 10½ inches long, spaced not less than 4 inches between centers; 72 of these tubes to be stay tubes. Back connections to be 2 feet 5½ inches long at bottom



IRON TUGBOAT.

and 2 feet 2½ inches at top, to be arranged in three separate compartments, each connected with its proper furnace. Grate bars of cast-iron in two lengths, each about 3 feet 7 inches long.

The material of hull is to be iron capable of withstanding a tensile strain of 45,000 pounds per square inch with, and 40,000 pounds across the grain. Keel to be formed of a bar of hammered iron 6½x2 inches, forged in as long lengths as possible with scarfs 18 inches long. Stem of hammered iron 6½x2 inches from keel to load water line, gradually diminishing to 4½x2 inches at head. The foot to be not less than 5 feet long and connected to keel with 18 inch scarf. Stern post of hammered iron 6½x2½ inches, with suitable eye and hub forged on for stern pipe and screw shaft. The stern post is to be reduced from where it enters the counter to 4½x2½ inches at deck beam to which it is to be riveted. The keel end of stern post to be not less than 4 feet 9 inches long, and connected and fitted to keel in the same manner as stem. The rudder post to be 5x2½ inches, with shoe or boss at lower end for foot of rudder stock. It is to be secured to stern frame at each end with a properly fitted scarf 12 inches long with five ¾-inch bolts, so that it can be disconnected to admit of removal of propeller or shaft. The connection between the two posts under the propeller to be 6 inches wide and 2 inches thick, and gradually reduced in width and increased in depth forward and aft, but maintaining the same sectional area. Clear distance between stern post and rudder post 48 inches.

Frames to be of angle-iron 3x3x⅜ inches, spaced 21 inches between centers, all to extend in one length from keel to gunwale. Bulkhead frames to be double. Intermediate frames, same size, to be worked in center of each frame space, from stem to frame No. 22, to extend from keel to about 3 feet above load water line.

Floors to be in one piece, 14 inches deep and $\frac{7}{16}$ inch thick from frame No. 22 to No. 45 inclusive, and ⅜ forward and aft, fitted and riveted to every frame; each floor to extend up the frames at least 15 inches above top of floors at middle line and molding at head to the size of frames. A limber hole to be cut in each floor. The bulkhead floors to be made 3 inches deeper, to facilitate riveting. Enlarged floors, with necessary angle irons and stiffening plates, to be provided for foundation of engine and boiler. Towards the ends of vessel the floors will be increased in depth to firmly connect the sides of vessel.

Reverse frames to be of angle-iron 3x2½x⅜ inches from frame No. 22 to No. 45 inclusive, and 2½x2½x$\frac{5}{16}$ inches forward and aft, one to every frame, extending across the middle line along the top of each floor plate to the upper bilge strake and gunwale alternately. On top of the reverse frames and along the center line of vessel there will be a center keelson of 10 inches by ⅜-inch plate with a pair of 3½x3x⅜ angle-bars riveted to top and bottom of plate, the lower angles to be riveted to reverse frames and doubling lugs. Keelson to extend into ends of vessel as far as practicable. Bilge stringers to be fitted at lower and upper turn of bilges, formed of two angle bars 4½x3x⅜ inches, riveted back to back, extending from stem to stern posts and finished at ends with breast hooks, not less than 5 feet 3 inches long in fore-and-aft direction.

Intermediate between center keelson and lower bilge stringer there will be run on both sides a side keelson, constructed substantially the same as bilge stringers, and extending from frame 23 to 43 inclusive. Half way between deck beams and upper bilge stringer there will be fitted on each side, and extending about two-thirds of vessel's length amidship, a side stringer of same dimensions and construction as the bilge stringer.

Deck beams to be of T bulb-iron on alternate frames, 6x3½x⅜ inches for three-fifths the length of vessel amidships; forward and aft they will be 5x3x⅜ inches, except beams at towing bitts aft, and riding and pawl bitts forward and at the hatches, which will be 6x3½x⅜ inches. Ends of frames to be split and worked into a knee, having 18 inches of bearing on frames, or else secured to frames with gusset plates ⅜ inch thick and 18 inches in length.

Stringers, one on each side 22 inches wide (increased at coal scuttles) and ⅜ inch thick for three-fifths length of vessel amidships, and $\frac{5}{16}$ inch thick for the remaining distance, with a gradual reduction in width to 15 inches at ends. Stringers to be connected to sheer strakes by angle-bars 3x3x⅜ inches, and riveted to deck beams and sheer strakes, to extend all around the vessel and be properly calked.

At the fore and main mast there will be riveted to the deck beams stringer plates 30 inches wide and of a length to cover two beams forward and two beams aft of the masts, and riveted to the deck beams. A mast hole of proper dimensions to be cut through these plates.

Similar tie plates covering three or four beams to be riveted to beams for support, and fastening of bitts, etc.

Plating in-and-out strakes, all horizonal seams to be lapped, and vertical seams to be butted.

Garboard strakes fayed next to frames, about 38 inches wide, $\frac{7}{16}$ inch thick for three-fifths length amidships, and reduced forward and aft to ⅜ inch. Sheer strake to be 42 inches wide ½ inch thick for three-fifths length amidships and reduced to ⅜ inch at ends. All other plating to be ⅜ inch thick for three-fifths length amidships and reduced to $\frac{5}{16}$ inch at ends, except the side plates that fit and fasten to the shaft boss of stern post, which shall be ½ inch thick.

Bulwark plates to be ¼ inch thick, riveted to sheer strake and frames. At the upper edge of bulwark plate there will be run the whole length an angle-bar 3x2½x$\frac{5}{16}$ inch, to which the rail will be fastened.

Bulkheads to be four in number and located on frames 9, 23, 46, and 52. They will be made of plate-iron ¼ inch thick, butt-jointed, about 30 inches wide, and running in one length from floors to deck beams, the lap strips or joints to be of T-iron 3x3x$\frac{5}{16}$ inches. Coal bunkers will extend along each side of engine-room and across on frame No. 43, as shown on drawing, and will be made of ¼-inch plate-iron, constructed substantially the same as bulkheads.

This boat is designed by Henry J. Gielow, engineer and naval architect, 29 Broadway, New York City.

LETTERS FROM PRACTICAL MEN.

Critical Notes.

Friction of Roll Bearings.

Editor American Machinist:

In a recent paper on Rolling-mill Notes, C. O. Sine makes a curious calculation, apparently proving by figures that .05 per cent. was too large a coefficient of friction to allow for bearings of rolls. It is there assumed that the pressure per square inch on the bearings was 5,000 pounds, and on this assumption it is shown that with .05 for friction it would take more power to drive the rolls than the engine could develop. As the 5,000 pounds per square inch is only guesswork, I cannot see why he did not make it 10,000 or 20,000, and thus get a wonderfully small coefficient of friction, and break the record all to pieces.

There are some facts about this kind of work which it is worth while to consider before coming to a conclusion about friction. Judging from the proportions of the housings and the circumference of the roll necks, the body of the rolls is about 20″ diameter, and constitutes what is called a 20″ sheet-mill. The heaviest work on such a mill is on the last or finishing passes of the sheet, and as they are seldom over 10 feet long when finished, a sheet will be passed through in two revolutions of the roll, which, at 40 revolutions per minute, would take three seconds. Then the sheet is put back over the top roll to be passed through again, so it is evident that one-half the time the rolls are doing nothing.

The engine which drives such a mill usually has a very large and heavy fly wheel, and if the work on the mill called for 700 horse-power while the piece was passing through the rolls, the energy stored in the wheel during the three seconds the rolls were empty plus the indicated horse-power of the engine, would be fully equal to the task, and have some power to spare.

The fact is, we do not know, and nothing but a dynamometer test or something of the sort can tell us what power is sometimes momentarily delivered to a mill of this kind. We can arrive at an approximate idea of it by the strength of the driving spindle, sometimes called the leading or breaking spindle, which connects the mill to the engine or driving shaft. This spindle is large enough to drive the mill under ordinary conditions, but when a dangerous load is thrown on the mill, this spindle sometimes breaks. The force which causes this spindle to break, of course, comes from the engine which drives the mill, for there is no other source for it to come from, and as we know approximately the torsional strength of cast-iron we can tell about what horse-power it takes to break the spindle. The sectional area of a 4-pod spindle, 12″ diameter, is about 81 square inches, or equal to a shaft 9″ square. The torsional breaking strength of a bar of cast-iron 1″ square and 3″ long is about 500 pounds applied at a leverage of one foot from center, but as the sectional shape of a spindle is not as good as a square to resist torsion, we will say 400 pounds is all it will stand per square inch. Calculating at that strength, it requires 2,217 horse-power to break it. As the engine in question is said to only develop 450 horse-power, the additional 1,767 horse-power required to break the spindle represents energy stored in the fly wheel, which is given out by a momentary retardation of its speed. Thus it may readily be seen that the coefficient of friction might be 0.1 at times, and the engine still overcome it, provided the fly wheel was heavy, and the work not absolutely continuous, which is generally the case unless very long pieces are being rolled.

BELL CRANK.

Turning that Curved Table.

Editor American Machinist:

After reading Mr. G. S. Collins' criticism on my letter, published in your issue of July 23d, I am forced to the conclusion that he did not read my letter carefully.

I did not say that I waited two days for the cutter to come round; it did not take quite so long as that.

I still maintain that the table could have been finished in a little more than one-fourth the time that it took the latheman to do the job—by using four cutters, without increasing the feed, and without having more than one tool cutting at one time.

Mr. Collins writes: "He might as well put eight or sixteen cutters in the bar," etc. This, I think, shows plainly that he did not understand what I wrote. He could not finish the job any sooner by using sixteen cutters than he could by using four, because it would take very near half a day for one cutter to run over the work. He could not use sixteen cutters, unless, indeed, he wanted to take sixteen cuts over the table, which was not at all necessary, four cuts being sufficient.

He did not grind the first tool until it had run over the entire table, and I repeat what I said in my previous letter, that, by using the tools as shown in the sketch, he could have finished the job by what would practically be one cut.

CHARLES STELZLE.

Looking for Information About Using Babbitt.

Editor American Machinist:

In replying to Question 324, you say, "All there is to it is to line up the shaft in its bearings," etc.

We have built a number of pouncing machines, and I have had trouble with the babbitt not filling the whole space between the shell of bearing and shaft. I have tried pouring the metal—which, by the way, is the best obtainable—from each end, and from both ends simultaneously. The bearings are ten inches long, $1\frac{3}{16}$″ steel shaft and ¼″ space for metal. The bearings are 10″ between.

Now, the trouble I experience is just this: on the inside of each bearing I find the metal is about $\frac{3}{64}$″ below the shaft, and, as the shaft runs 3,000 revolutions per minute, the bearings have to be scraped until accurately in line, and with a practically perfect bearing. In reading Bell Crank's opinion regarding babbitting, I was in hopes I would run across something that would give me a clue, but he does not touch the spot. If you or any of your readers can help me, I would esteem it a favor.

B. B.

Two Foundry Accidents.

Editor American Machinist:

Below you will find two accounts of foundry accidents, which I have clipped from the *La Crosse Chronicle*. Referring to the first one, the accident was more serious than stated, as it wrecked the furnace; size of furnace 36 inches diameter.

SMALL ACCIDENT IN A FOUNDRY.

There was an accident at the James foundry Thursday, that made quite a commotion, though it was not serious after all. A solid piston head went into the cupola with other iron to be melted, and there was probably some water in it that created steam and exploded. The cupola was blown out, and one man injured a little, but not so as to prevent his keeping at work. The damage was not important.

A SIMILAR CASE.

An accident of the same nature occurred the preceding day at Grand Crossing shops. A cylinder head being melted, exploded on account of water contained in it, filling Charles Lumley's face with cinders, and blowing a hole thr..gh the shop roof. Ordinarily a cylinder head does not go to the scrap heap until broken, and in any case is not supposed to be filled with water when screwed up. But sometimes water finds its way in through pores in the iron, so machinists say.

The similar case happened at the shops of the C., B. & N. R. R., but they do not run a foundry, and as near as I can learn by correspondence it was a piston head that was being repaired in the machinery department that exploded.

I think if they were readers of the AMERICAN MACHINIST they might avoid such danger. I think it a foundry foreman's duty to not allow any hollow castings, such as piston heads and that class of castings, to go in the furnace without breaking.

GEO. W. SMITH.

A Lost River.

According to the Los Angeles *Herald*, the Southern Pacific Railroad Company has lost a river, and in consequence has a bridge whose occupation is gone. The Whitewater River has flowed from the Sierre Madre Mountains across the sands of the region just this side of the Seven Palms, as long as any one can remember. The station of Whitewater was located where the river crosses the railway, and was supplied with water from its current. During the last heavy rains, the Whitewater rose in its might and devastated the whole country round about, washing out the bridge and the roadbed, and playing the mischief generally. Soon the rains and the river stopped simultaneously, and the river has not been found since. It appeared to become ashamed of itself for doing so much harm, and has apparently slunk away in disgust and sorrow. It is entirely gone. At no point does it cross the railroad, as it would have to do were it still in existence in some new course. The railroad company, in order to secure water for its station at Whitewater, has been obliged to build a pipe line way up to the mountains, at considerable expense. All last summer, during the hottest, dryest weather, the river ran placidly along—in fact, it has never failed until after its "jag" of this winter. Now it forms one of the mysteries of that mysterious region, the Colorado River desert, and perhaps is flowing by the Pegleg Mine, and possibly rippling beside the treasure-laden Spanish galleon, which lies somewhere in that region buried in the sand.

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CONTENTS.

	PAGE.
Duplex Planing Machine for Scarfing Ship Plates	1
"Standard" Saw-mill	1
Compound Engine. By James Tribe	1, 2
Cam Motions. By W. H. Booth	2, 3
Testing Yoke for Pop Safety Valves	3
The Institution of Naval Architects	3, 4
The Premium Plan of Paying for Labor	4
The Fowler-Henkle Printing Presses	4, 5
Too Much Knowledge	5
Iron Tugboat	5, 6, 7
Letters from Practical Men: Critical Notes—Friction of Roll Bearings. By Bell Crank.... Turning that Curved Table. By Charles Stelzle ... Looking for Information About Using Babbitt. By B. B... Two Foundry Accidents. By George W. Smith	7
A Lost River	7, 8
The Estimate System of Paying Wages	8
To Beat Steam	8
It was a Grinding Machine Book	8
The Rush for Patents	8
Literary Notes	9
Questions and Answers	9
Manufactures	9, 10
Explosions from Unknown Causes. By George Ross Green	10, 11
The Speed of the Steam Launch "Norwood."	11
To Collect and Deliver Parcels	11
Machinists' Supplies and Iron	11

The Estimate System of Paying Wages.

Mr. John Richards, in his journal *Industry*, comments upon Mr. Halsey's paper upon the premium plan of paying wages, and says it is only a clumsy adaptation of a plan which has long been used in England, and which he thinks is much superior to Mr. Halsey's or any other plan in use in this country. Mr. Richards says that he has heretofore explained the system at some length, but that no one here seemed to understand it, and we are not sure that we now understand it any better than before, for the reason that some of the features of the system seem much more complicated than any other we know of, without compensating advantages so far as we are able to perceive.

It is called the "estimate system," and, according to our understanding of it, may be described as follows:

When an engine or other machine is to be built its selling price is divided into four parts: material, labor, expense and profit. The cost of the material is found by estimation, in the manner that is familiar to all manufacturers; expense is estimated from precedents, and profits are assumed at a fixed amount. The cost of the labor is estimated by means of tables and fixed rates for the performance of the various operations, these rates being fixed in England "by the concurrence of wide districts, and the precedents of many years." The rates and the methods of computing the labor cost are declared to be entirely familiar to and well understood by both employers and workmen, such shop processes as casting, forging, turning, drilling, planing, fitting and so on, being classified and subdivided into grades, for which different rates are allowed.

For example, planing and turning are divided into four grades, for each of which there is a different rate for each 100 inches of area, and so on for other processes, casting being rated by the pound at different figures, according to the class of work; plain, gear, cored work, etc. Forgings are rated by the pound, and pattern work as a percentage.

During the progress of the work in the shops the men are paid a daily or weekly rate of wages, and the time spent by each man on any certain job is carefully recorded. When the job is completed the wages which have been paid out during its progress are deducted from the original amount allowed for the cost of the work, and the difference is paid to all who have participated in it, in proportion to the time put in on the job, and to the rate per day for each man, which, of course, varies with the class of work done, and individual ability.

The results of the system are summarized by Mr. Richards as follows:

(1.) The owners are relieved from the responsibility of the "rate of wages" among the workmen. The men themselves see that this is equitably graded and in proportion to capacity.

(2.) The owners are also relieved from the care of seeing that men perform a day's work. This is also looked after by the workmen themselves. Any one not doing a fair day's work is reducing the "surplus" and robbing his fellow workmen.

(3.) The owners are also relieved from losses from spoiled or "scamped" work, also from breakages due to ignorance and negligence. The men make these good.

(4.) The workman can favor or support any one who is unfortunate, or incapacitated by accident or sickness from doing a full day's work. The system may thus be made a benevolent one.

(5.) The owners "know" what the labor will cost, and consequently know what their profits will be, if other elements are made up with equal exactness.

(6.) It constitutes the workmen interested partners, in so far as their work goes, without any object or desire to participate in other things, such as material, expense or profit. It also creates a feeling of personal responsibility among workmen, that is unknown in any time system.

(7.) It furnishes standards for "tool performance," and acquaints both workmen and owners with the merits and capacity of implements. The day's and hour's work of machines becomes known to both users and makers, hence it is common in England to specify capacity in tenders for machine tools.

We know of at least one prominent concern in this country where a system similar to this has been in operation for a number of years in the case of new machinery *i. e.*, machinery differing more or less from any that has preceded it. The bulk of the work is done on the ordinary contract system, and when a new machine is to be built a price for doing the work is fixed by mutual agreement between the proprietors and the men doing the work of the class to which the new machine belongs. This price is based upon experience with other machines as near like it as can be selected, and the ordinary income of the men is guaranteed, with the privilege of making as much more as possible. But it is worthy of note that if there are other machines built afterwards of the same kind they are built by contract.

We do not just see how wide districts or the precedents of many years can well be recognized in making up estimates of cost of work in this country, for the simple reason that the cost of work is constantly and rapidly decreasing in most instances, and it differs considerably in different parts of the country, and even in different shops in the same locality, so that it seems to us that estimates would be much better made upon a basis of the experience in the shop where the work is to be done alone.

With either system unreasonable men on either side can defeat the object in view. The English system certainly would require very much more bookkeeping than any other with which we are acquainted, but, as Mr. Richards says, bookkeeping is cheap there. The system certainly has its good points, one of which is that it can be applied to machines built for the first time, which, perhaps, would not be so easy with the system proposed by Mr. Halsey, though in this country it is common knowledge that turning, planing, drilling and other such operations cost far less on the fiftieth or the hundredth machine than on the first one, and we do not notice that the English system allows for this any more than does that of Mr. Halsey, for with either of them a time would come when a readjustment would be demanded by one side or the other.

The best feature of the estimate system seems to be that it makes it to the interest of each man in a shop to see to it that every other man does a fair day's work, and, when he does it, relieves him of responsibility to those who, in the nature of the case, must know far less of what constitutes a fair day's work than the men themselves.

To Beat Steam.

The schemes to beat, in an economical way, steam made from water as a working fluid in an engine, have been, and will undoubtedly continue to be numerous. There is, beyond question, a wide field for the gas engine and the hot-air engine, for small power, not because either gas or air is, *per se*, more economical than steam, but because the conditions are sometimes such as to make the use of either gas or air advisable. The whole problem is concluded by the conditions that surround the case. That is, while it might be advisable to use gas or hot air for small power, no one would expect to run a two hundred horse-power engine as cheaply with gas or hot air as with steam. But the fact that some fluid other than steam is best in such instances leads a good many to believe that steam is a poor medium.

Then in the instance of electric motors, they are in many instances an excellent means of distributing power, but in discussing their use they are most ridiculously placed in the position of prime movers, as if, in nine cases in ten, their use did not make room for a very material increase in steam power.

An old idea is to use air and steam in combination. We have no knowledge of how old this idea is. But more than thirty years ago a farmer of Rensselaer County, N. Y., "invented" an engine in which a mixture of steam and air was to be used. He sold his farm to put his idea into practice, and after building an engine refused one hundred and fifty thousand dollars for a part interest, and the outcome was that he lost all he invested.

This scheme, in various forms, has come up ever since, and with great regularity. Sometimes it has taken the form of injecting air into the boiler, there to be heated and mixed with the steam; sometimes some other means of bringing about the mixture of air and steam was employed.

The latest move in this direction is being made by Edward Field, C. E., of England. Mr. Field is well known by the boiler that bears his name, and he is impressed with the idea that by his plan of mixing a little steam with a good deal of heated air he will bring about important economical results.

As in most other cases of the kind, Mr. Field starts out with the rather popular fallacy that the air can be heated—up to 400°—by waste heat, practically without cost. However, it is said that he makes a saving of between forty and fifty per cent. as between his mixture and steam pure and simple—a statement which we shall be glad to see verified, but in which, at the present, we have not the least faith.

It was a Grinding Machine Book.

In our issue of August 13, page 8, we should have said that the Brown & Sharpe Manufacturing Company published their book, "Construction and Use of Universal and Plain Grinding Machines," in cloth as well as in paper. Unfortunately, we wrote "milling machines" instead of "grinding machines," hence this correction.

The Rush for Patents.

After making all due allowance for patents taken out for good reasons not readily apparent to others, it must be evident to any one who occasionally looks over the *Patent Office Gazette* that many patents are granted every week upon devices that are utterly and hopelessly worthless, and for which the inventors can never reasonably hope to get back a single cent of the money expended upon them. This is, of course, largely due to the fact that so large a proportion of the patents taken out are for the inventions of persons entirely unacquainted with the particular line of work or business to which the invention relates. But it is also true that many of these worthless patents are granted to those who should know their worthlessness, and who probably would perceive it, if, before applying for a patent, they would give themselves sufficient time to thoroughly investigate, by actual trial or otherwise, the question of practical merit. The idea is altogether too prevalent that there is no time for this preliminary investigation or trial, and that when a new idea is conceived, presumably valuable, the only safe course is to rush immediately for a patent attorney's office and get an application filed.

The fact is, however, that an invention may be in use for two years previous to an application for a patent upon it, and if during the development of the invention and its trial during this two years, with a view to perfecting it, sketches be made, dated and witnessed, the invention is almost if not quite as safe in most cases as if an application for a patent had been filed.

If this were more generally understood there would undoubtedly be fewer worthless patents issued, and much money would be saved by those who usually need all they have. There seems to be an inclination upon the part of some to blame the patent solicitors for the large number of worthless patents, and some of them by their highly colored advertisements do undoubtedly stimulate the business of taking out absurd patents, but at the same time many obviously worthless patents are solicited by them for much the same reason that doctors sometimes prescribe medicines, *i. e.*, not because the patient needs them, but because he expects them, and will have them before he will be satisfied, in which case bread pills and *aqua pura* answer every purpose. Many patents are simply bread pills.

Literary Notes.

The *Compass* is the name of a new monthly journal for engineers, surveyors, architects, draftsmen and students. In the first number, which has just been published, it is announced that the endeavor will be to give such information respecting the construction of mathematical and surveying instruments, with the best modes of using them, new and improved methods of procedure, etc., as may both interest the engineer, surveyor, draftsman or student, and be of practical value to him in the pursuance of his profession. The theories and principles relating to the above will also be examined, whilst new inventions in the same kindred branches, whether domestic or foreign, will receive that attention to which their merits may entitle them. It is proposed that each number shall, as far as may be practicable, contain articles treating of the following subjects: 1. A practical and descriptive one devoted to instruments for outside field work. 2. A similar one devoted to instruments for office work. 3. An article treating theoretically of the principles which underlie the construction and use of such instruments. 4. Descriptions of novelties; short reference to materials and other objects in use; foreign information; miscellaneous items of interest to engineers, etc. The journal is edited by William Cox, who, by his previous contributions to other technical papers, has shown himself to be thoroughly familiar with the subjects mentioned above, and will make the future issues instructive ones, of which the first one bears ample evidence. The number before us contains 16 pages of reading matter, size of page 9 by 5¼ inches. The subscription is $2.00 per year; single copies, 20 cents each. It is published by Keuffel & Esser Co., 127 Fulton street, New York City.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(381) G. R. A., Providence, R. I., writes: I wish to construct an anti-friction bearing. The rolls are to be 15 inches long, and to sustain a weight of 15 tons. Of what material should the bearing be made, and how should it be case-hardened? *A.*—Your question is so indefinite that we are unable to answer. You should give the conditions under which the rolls are to work, and the speed of the journals.

(382) F. B., Brooklyn, N. Y., writes: Kindly let me know through your columns whether a young man (19 years of age) can apply for a position as oiler on a steamship without having had any previous experience. *A.*—We know of nothing to prevent you from applying; neither is it absolutely necessary for you to have any previous experience, although experienced hands receive more pay than beginners. 2. To whom should I apply, and what are the wages? *A.*—Apply to the chief engineer of the vessel. There are no set wages; make as good an agreement as you can.

(383) F. R. K., The Dalles, Oregon, asks: What would be the best books for me to get to learn steamboat engineering? I have worked two and a half years at the gunsmith trade under a first-class man. Do you think I could learn to be a good steamboat engineer by studying books? *A.*—No; you will of course require a fair education, and this you may obtain from the books recommended in our issue of February 19, current volume, in the article on "What to Study." But you cannot obtain from books the practical experience which all good engineers must possess, and without this you cannot obtain the confidence of employers.

(384) A. W. J., New Britain, Conn., writes: I would like a little advice through your columns regarding schools. I am contemplating taking a course in mechanical engineering, but hardly know what one to prepare for, and would like you to answer one or two questions. 1. Does the Worcester Polytechnic Institute rank among the first, say with Cornell, the Mass. Institute, Stevens, etc.? 2. Would the Worcester Institute, in your estimation, be as good for a young man (a good mechanic) of 23 as some of the others mentioned, taking into consideration the fact that its course is three years, and that of the others four? 3. How does the Ohio State University rank? *A.*—You may rest assured that all these institutes engage the best professors that can be obtained, and that the students will obtain an excellent training in the course of study laid out in each institute. Send for their catalogues and make your own selection.

(385) W. S., ——, Mass., writes: I have a Fitchburg engine of the old style in use, and a short while ago we had to have a new crank put on, and I think they sprung the shaft a little. Now every time she goes over the center furthest from the cylinder there is a grating noise, and it sounds as if the fly wheel was going to break. The wheel has been tested, and is all sound. The piston travel is equal. The engine is a 100 H. P., runs 82 revolutions, 70 pounds steam pressure. What is the trouble? *A.*—The proper way to determine the trouble is to find out whether the shaft *is* sprung or not. This may be the case, or the crank-pin may not be true with the shaft. These, a good machinist used to setting up steam engines can very readily determine. Examine the fastenings of the fly wheel to the shaft; sometimes a wheel works on the key and makes a very disagreeable noise; very likely your engine requires a thorough lining up by a competent man. A good engineer will soon locate the trouble.

(386) J. C. H., Worcester, Mass., writes: I am a young man (25), have served an apprenticeship of four years at the machine trade, and have also worked as journeyman for 3½ years. I have a great liking for the business, and wish to advance myself. I have taken four terms at drawing school; but my education in arithmetic goes only as far as fractions. I intend to take instructions during the coming fall and winter, in the evenings, of course, as I have to work every day. If I find that I can advance fast enough, I intend to try for a college course. Now what I wish to know is what books should I use to prepare myself? 2. What will be the cost of instruction in college? 3. With a little push and energy, how long does it take to graduate in the mechanical line? I wish this information, as I have to make some provisions in my cash account. *A.*—In our issue of February the 19th, current volume, we have laid out a course of study to be followed, and have named the books to be used. But if you engage an instructor, as we understand you to say, we should advise you to allow him to make the selection of books. The cost of instruction in colleges varies, and you may obtain this information by writing to the principals or presidents of the colleges. In the night schools of Cooper Union, New York, you can obtain the education free. With the aid of a good instructor you may, in two or three years, acquire the necessary qualification to pass an examination for entering a college. The regular college course usually requires four years for its completion. In Cooper Union five terms are required; but in this institution the instruction is given in the evenings, which will enable you to work during the day.

(387) J. P., Baltimore, Md., writes: I have read your paper, and I believe that it will help me to become a good machinist, which is my only desire. I have learned the locksmith's trade in Germany, but I do not like it; and besides I find that in this country it does not amount to much. I cannot serve an apprenticeship, as the wages are not sufficient to pay my board, and the consequence is that I had to do laboring work. Sometimes I get a chance to work a drilling machine or a bolt cutter, but I have never been put to work on a planer or a lathe, for which I have a great desire. I shall esteem it a favor if you will kindly advise me what to do. (Our correspondent states much of his trouble that he has had to contend with, and which we need not repeat here.) *A.*—From the tone of your letter we should judge that you have been brooding over your misfortune instead of using your time and energy for your advancement. Our advice is, save all the money you can, and when you have a sufficient amount laid away to defray your expenses for about a year, then enter a machine shop under instructions, and in the meantime devote all your leisure hours to the study of mechanical matters. It is absolutely necessary that you should understand drawing, and also have fair knowledge of mathematics, the more the better. A machinist must know more than running a planer or a lathe. You state that "where there is a will there is a way, but there is no way for me." Here is where you are wrong; there is a way for you as for any one else. Use your time and energy for your advancement. Do your work cheerfully and faithfully, whatever that may be; above all establish a good moral character, and get some of the American push in you, and you will not fail to succeed.

(388) W. H. W., New Haven, Conn., writes: Kindly inform me what the average steam pressure is on a piston, if steam is admitted at 61 pounds, and cut off at one-quarter stroke. Also give your rule for determining the same, and work out the above example for illustration. *A.*—The mean pressure per square inch is 45.11 pounds; for the mean effective pressure the back pressure must be deducted from the above. The rule for computing the mean pressure is as follows: Add one to the hyperbolic logarithm of the ratio of expansion, divide the sum by the ratio of expansion, and multiply the quotient by the absolute initial steam pressure; the product will be the mean pressure per square inch on piston. Applying this rule to your example, we have: Since steam is cut off at ¼ stroke, the ratio of expansion is 4. The hyperbolic logarithm of 4 is 1.386; adding 1 we get 2.386; dividing this by the ratio of expansion (4) we have $\frac{2.386}{4} = .5965$; and multiplying this by the absolute initial steam pressure, which is equal to 61 + 14.7 = 75.7 pounds, we obtain for the mean pressure per square inch on piston .5965 × 75.7 = 45.15505 pounds. If now the back pressure in a non-condensing engine is 1.5 pounds per square inch, the absolute back pressure will be 1.5 + 14.7 = 16.2 pounds; and the mean effective pressure per square inch of piston will be 45.15505 — 16.2 = 28.95 pounds. In this example clearance has been neglected, which, if taken into account, will change the result a little. The hyperbolic logarithm is taken from a table which may be found in any good book on steam engineering. As we have previously stated, the rule as above given is to be found in most books on steam engineering, but we give it here in response to many requests to do so, with an example.

(389) A. P., Arizona, writes: Kindly answer the following questions: 1. Why does the turning down of an eccentric decrease the travel of the valve? *A.*—So long as the distance between the center of axle and the center of the eccentric, that is, the eccentricity of the eccentric, is not changed, the amount of travel of the valve will not be changed, no matter how much there is turned off the eccentric. But it may happen that in turning down the eccentric, and then replacing the old strap by a new one, the distance from the center of eccentric to the center of eccentric rod pin may be changed through carelessness or want of thought, and this will change the *relative* travel of the valve, just as it will be changed by altering the length of the eccentric rod without turning down the eccentric. 2. What is the motion of a crosshead in a locomotive which is traveling ahead? A great many engineers here contend that the crosshead always travels ahead, but never back. I argue that it travels both ways, but in going ahead three and a fraction times faster than when going backwards, as the top part of the driving wheel moves three and a fraction times as fast as the bottom. *A.*—You are pretty well muddled up on the subject. Since there is nothing in the universe which is stationary, two bodies can only be in motion relatively to each other. In considering the motion of two bodies it is customary to assume one of them to be stationary, or, what amounts to the same thing, no attention is paid to the motion of one of the bodies. If now the relative motion of the crosshead and the earth is considered, and we assume the earth is stationary, then the crosshead in a locomotive which is going ahead will always travel forwards, and never backwards. Of course when the crosshead travels in a forward direction its velocity will be greater than when traveling in a backward direction. If, on the other hand, we consider the relative motion of the crosshead and axle, or, in other words, if we consider the axle to be stationary, then the crosshead has a forward and backward motion. And since the velocity of the crank-pin can be assumed to be uniform, the crosshead travels backward as fast as it travels forward. The velocity of the top and bottom of the driving wheel has nothing to do with the subject in either case.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 20.
Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.
Shafting Straighteners. J. H. Wells, Tampa, Fla.
"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.
Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.
Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.
Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.
Ice and Refrigerating Machines, 170 sold, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.
Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.
Crank Pin Machines. Pedrick & Ayer, Philadelphia, Pa.
Planer Chucks—Greenwood's Universal. Pedrick & Ayer, Philadelphia, Pa.
Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.
$13.00 I. Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.
To get the best work out of a Star Hack Saw, bear down heavily, and draw it very slowly.
S. A. Smith, 23 So. Canal St., Chicago, Ill., agent for Appleton Mfg. Co.'s Emery Grinding Machinery.
Our Automatic Gear Cutting Machine will increase production 50%. The Superior Mach. Wks., Clev'd, O.
Boston Gear Works, Boston, Mass. Gear cutting of every description; noiseless gears a specialty.
Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.
For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.
S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.
For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.
Save small iron from foundry refuse. It pays. Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.
"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.
Hyd. press, hyd. jacks, steam tables, accumulators, cutting and stamping dies for sheet metal, foot press, etc. S. Hartley, 245 N.J.R.R.Ave., Newark, N.J.
Self-adjusting Hand-Screw for Pattern and Cabinet Makers, Wood Workers, etc. Sample by mail for 50 cents. Wm. H. Denney, Lancaster, Pa.
Upright Drills and Iron Planers, for immediate delivery; prices reasonable. J. E. Snyder, Worcester, Mass.
Young & Shackell, manufacturers' agents and promoters of patents; correspondence solicited; 366 Broadway, Milwaukee, Wis.
Any book advertised promptly sent on receipt of price. Send for complete catalogue. Norman W. Henley & Co., 150 Nassau Street, New York.
25″, 32″, 37″, 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.
DuBois & DuBois, Patent Attys., 715 11th St., Washington, D. C., procure first-class patents. Send stamp for illustrated pamphlet, "March of Invention," containing valuable information, and list of references.
Maxims and Instructions for the Boiler-room, by Prof. N. Hawkins. Part 5, just issued (25c.) Send 25 cents for Part 1, and order blank for the Series of 10 parts. Catalogue. Theo. Audel & Co., Pubs., 91 Liberty Street, N. Y.
Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo., cloth, $8. Catalogue of books on mech. subjects free. E & F. N. Spon, 12 Cortlandt St., New York.
De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.
Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.
"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.
"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Manufactures

The erection of a $12,000 ice factory is contemplated at Kentwood, La.

The Stratton Ice Works, Pensacola, Fla., will, it is reported, put in a new ice machine.

There is talk of the erection of a bridge across the Watauga River, Allentown, Tenn.

A co-operative company is being talked of at Belmont, N. C., to erect a cotton-mill.

A foundry and machine shop is to be established at the State University, Lexington, Ky.

W. P. Thompson and J. R. Williams are, it is reported, erecting a machine shop at Opelika, Ala.

The city council (Birmingham, Ala.,) will be petitioned to build a bridge across Nineteenth street.

A three-story addition is to be built by the Victoria Cordage Company to its works at Dayton, Ky.

The Excelsior Iron Works, Chicago, will erect a five-story machine shop, 74x91 feet, at a cost of $40,000.

The Woonsocket (R. I.) Machine and Press Company has been making quite extensive additions to its works.

The Pitman Manufacturing Company, of Laconia, N. H., are to build new buildings at an expense of about $20,000.

The Orswald Mill, at Fitchburg, Mass., is to have a new addition, which will contain 15,000 spindles, running by October.

Southworth Brothers, of Ware, Mass., have leased 3½ acres of land on which to build a box shop, grist-mill and machine shop.

It is stated that a plant for manufacturing paper boxes is to be put in at the Pulaski Knitting-mills, Savannah, Ga., now building.

The H. N. Slater Woolen Company are building a new three-story brick mill at Webster, Mass., and will equip it with new machinery.

A. R. Steele, J. M. Shaw, W. L. Shattuck and others have incorporated the Union Cotton-mills, to erect the cotton-mill at La Fayette, Ga.

There is water-works agitation in Muskegon, Mich.; Macon, Ga.; Portland, Me.; McKeesport, Pa.; Seattle, Wash.; Everett, Pa.; Duluth, Minn.

The Phosphor Bronze Smelting Company, 512 Arch street, Philadelphia, has issued a revised price list of materials made from phosphor bronze.

A company will, if the county votes for bonds to deepen the river, establish a fertilizer factory at Jacksonville, Fla. Mr. Ambler can give information.

A new two-story addition is being built on the northeast corner of the Hathaway Weaving-mill, New Bedford, Mass., which will be filled with looms.

It is said that the adjustment of freight rates for Chattanooga's (Tenn.) benefit, would secure the establishment of a plant with an annual product of $1,500,000.

The Blake & Johnson Company, of Waterbury, Conn., are about completing a new machine shop, 200x45 feet, two stories high, with basement and storage-rooms.

It is proposed to erect an ice factory with a capacity of 2,000 tons per day at Chickamauga, Ga. The Crawfish Springs Land Company can probably give information.

A proposition for the erection of an ice factory and cold storage plant at Arkansas City, Ark., will be made to the Board of Trade. Marks & Davis can give information.

The Mills Improved Pneumatic Brake Company, of Chicago, was incorporated in Illinois last week, with a capital stock of $600,000, by W. Mills, W. B. Mills and O. A. Bogue.

The new plant of the Missouri Malleable Iron Works, at East St. Louis, is being pushed toward completion. Over 1,000 men will be employed when the works are in operation.

A new company, with a capital of $25,000, is being organized at Adams, Mass., to run the business of the Linneth Manufacturing Company of Newark, which is to remove to Adams.

W. S. Witham, of Anniston, Ala., and W. L. Dresser, of Albany, N. Y., are erecting an electric light plant; also power plant at Newnan, Ga. Total cost will be about $25,000.

It is stated that the Hopedale (Mass.) Machine Company will enlarge its works immediately by building two three-story buildings, one of brick, 80x50, and the other of wood, 100x100.

The Beloit Brass Works, at Beloit, Wis., have passed into the hands of a new company, who will improve the works and operate them under the style of the Architectural Metal Works.

The plans adopted for the new buildings of the Hanover Foundry and Machine Company, at Gettysburg, Pa., embrace a machine shop, 90x140 feet, and a foundry 60x70 feet, both of brick.

The Buffalo (N. Y.) Steam Forge Company, which has been operating the Sayre Forge, at Waverly, N. Y., has decided to remove the latter works to Buffalo, where the main plant is located.

It is rumored that the Winona & Southern Railway Company have purchased the Winona Harvester Works, at Winona, Minn., and will convert them into an extensive car manufactory.

According to rumor, the Central Railroad & Banking Co. (office, Savannah, Ga.,) will remove its Augusta (Ga.) repair shops to Columbia, S. C., and consolidate same with the Richmond & Danville shops at that point.

A. A. Lehman, Albert Goldstein, P. R. Vogel, Jr., and others have incorporated the Lehman Manufacturing Company at Baltimore, Md., to manufacture and sell pneumatic and electrical supplies; capital stock, $10,000.

Nelson W. Twiss, 28 Whitney avenue, New Haven, Conn., has issued a new catalogue of the Twiss improved automatic engine; also of vertical and yacht engines. Detail cuts are given showing the construction of various parts.

The Proctor Steel Company, in which J. E. Kelley and others, of Louisville, Ky., are interested, will erect a steel plant at Johnson City, Tenn. The plant will be of from 100 to 150 tons daily capacity and will cost about $400,000.

The Midvale Steel Works, Nicetown, Philadelphia, are contemplating the erection of a steam crane having a lifting capacity of 150 tons, to travel on a bridge 100 yards long, extending from the open hearth to the ordnance forging department.

The Hercules Foundry Company, incorporated in Massachusetts with A. L. Rand, president, and O. B. Cole, treasurer, has recently purchased, and will complete the iron foundry of the Pike Manufacturing Company, to be located at Pell City, Ala.

Messrs. Keatly, Cates and Hastings, of Boston, Mass., have purchased 440 acres of pebble phosphate land near Bartow, Fla., for $40,000, and will incorporate the Bone Valley Phosphate Company (in Massachusetts) to develop same and erect works.

The Link-belt Engineering Company (Nicetown) Philadelphia, Pa., and 49 Dey street, New York, has issued a revised price list of the great variety of work furnished in all kinds of link-belt chain and rope transmission, with a large variety of appliances employed.

The Vulcan Iron Works, located at New Britain, Conn., and owned by the Bridgeport Malleable Iron Company, are to be enlarged by the erection of two new buildings 70x227 and 47x106 feet respectively; they will be only one-story high, but will have every modern appliance.

The Boscawen Mills Company have been incorporated, with a capital of $50,000, to do a general manufacturing business in the old Contoocook Mills in Boscawen, N. H. The incorporators are S. C. Eastman, John Kimball, S. S. Kimball, W. P. Fiske, George M. Kimball.

Additions are being made at the iron axle-mill of Irondale, O., which, it is stated, when completed, will be used for the manufacture of tin plate. The mill will be fitted up with the latest machinery for the manufacture of tin plate, and will give employment to about 75 more men.

The Southern Land Improvement Company, of which M. E. Truax, New York Life Building, Minneapolis, is superintendent, will develop a large tract of timber and iron land at Pineville, Ky., and will soon be in the market for foundry and machine shop supplies as well as railroad material and equipment.

The Proctor Steel Company are talking of moving to Johnson City, Tenn., where they have been offered very flattering inducements to establish an immense steel plant; this company is the only one in America that use the Russian steel-making process, and they are said to be the largest plant of the kind in the country.

The Jasper (Tenn.) Iron Company, recently chartered, has been organized by J. H. Baker, of Allegheny, Pa., with a capital stock of $600,000; paid-in capital, $197,000. The company proposes to erect plant of brick and iron with complete outfit of new machinery, to manufacture field hardware, car forgings, bar iron and steel, etc.

J. E. Lonergan & Co., of Philadelphia, have just received an order from the Warden Manufacturing Company, of Germantown, for 96 three-inch pop safety valves, to be used in the plant of the Third avenue cable railway in New York City. This, it is claimed, will be, when completed, the largest plant of its kind in this country.

The Como City Land Company is to lay off into lots and otherwise improve its 600 acres of land at Lake Como, near Woodlawn, Ala. It is proposed to erect electric light plant and brick works, and secure manufactories, special inducements being offered for a cotton-mill. Office of company is at Birmingham; J. B. Ware, president.

At the Norristown Steel Company, near Norristown, Pa., active preparations are going on for starting the works at an early day. One steel furnace is entirely completed, and is now being dried out, while the foundations for a second furnace are laid. The different appliances of the works have been tested, to the entire satisfaction of the management.

The Richards' Momentum Brake Company, of Jersey City, N. J., has filed articles of incorporation, the capital stock being placed at $100,000. The company will manufacture and place upon the market the Richards' patent momentum car brake. The interested parties are H. S. Richards, of Orville, Pa.; Lindley Murray, 28 Seventh avenue, Brooklyn, N. Y., and A. A. Rice, Jersey City, N. J.

Articles of incorporation of the Minneapolis Malleable Iron Company were filed in Minnesota last week. The capital stock is $50,000. The works will be located at St. Louis Park, Hennepin County, Minnesota. The following are the directors: Geo. T. Leitch, A. M. Allen, G. M. Walker, Minneapolis. G. M. Walker is president, G. T. Leitch, vice president and manager, and A. M. Allen, secretary and treasurer.

The Fairmount Woolen-mills, at Queen City and Harrison avenues, Ohio, were recently burned. Through the efforts of firemen and employes the fire was confined to the third and fourth floors, saving the whole building and $100,000 worth of stock and machinery. One hundred and forty girls were employed in the building at the time, but all escaped unhurt. The loss will reach $20,000, fully covered by insurance.

Engineers Hull & Palmer, of Bridgeport, Conn., are perfecting plans for building a dam on the Housatonic River at Stockbridge, Mass., for the Monument Mills. Power is to be furnished in this way for running a 600 horse-power electric light plant, from which the Monument Mills will light their factories, and also the village of Stockbridge. This is the first definite move to utilize the water-power of the Housatonic, resulting from the recent agitation.

The new electric light plant for the Pawtucket Gas Company, at Pawtucket, R. I., will be very substantial. The dynamo-room will be 60x150 feet, the engine-room 58x78, and the boiler-room 60x80 feet. The side walls will be of brick with iron roof covered with corrugated iron. The whole plant will be built by The Berlin Iron Bridge Company, of East Berlin, Conn., after the plans and specifications of Remington & Henthorn, engineers and architects, of Providence, R. I.

The Milford (Mass.) Water Company have started on the following improvements and additions to their plant, to meet the requirements of the fire service, as per contract with the town: A new boiler-house is to be erected, to contain two 100 H. P. boilers, made by Wm. Allen & Sons; a new chimney, 70 feet high, and a new Worthington 2,000,000-gallon pump is to be added. These changes will double their present capacity.

The new shop which the Northampton (Mass.) Board of Trade have built for N. B. Crosby, the Cummington manufacturer, is ready for occupancy. The structure is a plain but substantial wooden building, with boiler-house of brick, one-story high, the rooms being 14 feet in the clear. The main shop is 140x35 feet, with an adjoining building for the three dry-houses 42x44 feet. A 50 horse-power boiler and engine has been set up, which will give the concern ample power. Mr. Crosby expects to get the machinery all running by Monday. He will employ some 25 hands in the manufacture of wooden handles of all kinds, mostly of the ebonized style. The building cost about $3,000, which was subscribed through the Board of Trade.—*Commercial Bulletin.*

A Chicago dispatch says: The National Forge and Iron Company, manufacturers of bar-iron, car axles and forging, and makers of railway and car construction works, having a general office in this city, and works at East Chicago, Ind., made a voluntary assignment to-day. This company and its predecessors has been doing business many years, and has a capital stock of $300,000. Gilbert B. Shaw, president of the American Trust and Savings Bank, was appointed assignee, and gave bond in $700,000. The assets of the company are said to be from $350,000 to $400,000, and the liabilities about the same. The failure is due to the depression in value of iron and other metals, and to the failure of the Union Rolling Stock Company, which owed over $50,000 to the National Forge and Iron Company.

The old Swift's Iron and Steel Works, at Newport, Ky., which has been idle for several years, and which was recently purchased by the Cincinnati Corrugated Roofing Company, has been started up, and is now running at full blast. There are eight puddling and two scrap furnaces in the old mill, and two sheet-mills in the new mill, in full operation, and two sheet-mills in the old side. The plant is being run almost entirely for the turning out of sheet-iron, which has to be transferred to Cincinnati to be corrugated. This incurs a large and unnecessary expense, and the probabilities are that the corrugating works will be added to the mill proper in Newport, which will necessitate the increasing of the number of employes, which is now about 250 men. The entire concern is now under the superintendency of Mr. L. P. Hubbard.

We are informed by Mr. James Emerson, of Willimansett, Mass., that the item that appeared in these columns Aug. 20, relating to manufacture of the Emerson car heating apparatus, is incorrect. From printed matter which he sends us, we should infer that a company with a capital of $500,000 had been formed, but that Springfield had not been fixed upon as the place of manufacture. The printed slip, which Mr. Emerson endorses, states that he "has turned over his railway heating and coupling inventions, about 20 in all, to the United Railway Car-heating Company, a corporation just formed, with a capital of $500,000." Mr. Emerson also sends us a circular of "The United Railways Safety Car-heating Combination," of which he says "it gives all particulars of object of company and purpose of system." On the inside leaf of this circular appears twice, "The Emerson Car-heating Company, Springfield, Mass."

The W. H. Warren Machine Tool Works, which make radial drills, shaping machines and special machinery used largely by the United States Government in its various arsenals for the manufacture of heavy ordnance, received orders in June for several large machines to go to the Watertown arsenal. Yesterday the concern received notice that its bids for five heavy machines for the Watervliet arsenal, Troy, N. Y., have been accepted. The contracts amount to about $25,000, and as the bids of this concern were the highest and not the lowest, reflects much credit on Worcester enterprise and brains. In fact, the Warren machines have been accepted as a standard of excellence by the government, which states in its contracts that the machines "shall be equal to the Warren machines." This firm has in other bids which may result in bringing many thousand dollars to Worcester, which has always stood high with government superintendents as a center for good machinists and good machinery.—*Worcester Daily Telegram.*

We take the following in relation to a new concern from the Meriden (Conn.) *Daily Republican:* "Though it has been organized less than two years, the Meriden Tool Company has already built up a flourishing trade among the users of the finest grade of machine tools. The company now occupies the entire second floor of the big Lanagan building on State street, and is likely to soon need more room. Not long ago an engine and boiler of double the capacity of those the firm formerly used were procured to meet the demands of their business. The firm makes a specialty of manufacturing "forming lathes" for silver manufactures, and supply many of the leading firms in that line, not only in Meriden, but in several States. They have just completed the first of ten key-seat milling machines, of very fine construction, for the Woodruff Manufacturing Company, of Hartford. The tool company is composed of H. Wales Lines, R. L. Peck and W. L. Cheney."

The steamship "State of California," built for the Allan-State line, which was launched in January, sails from Glasgow for New York on her maiden voyage next Friday. The "State of California" is built of mild steel, and is classed A1 in Lloyd's under special survey. She is 400 feet long over all, 46 feet beam, and 32 feet 8 inches molded depth, and will have a gross register tonnage of about 4,500 tons. The vessel is divided into eight water-tight compartments, the bulkheads of which are all carried to the upper deck, so as to insure the greatest amount of safety in case of accident, and has also water ballast tanks in cellular double bottom fore and aft, which can be filled or emptied expeditiously.

The "State of California" is the first high-class passenger steamer added to the Glasgow and New York trade for a number of years, and is designed to attain the highest speed possible, with capacity for sufficient cargo to insure good earnings from freight, even with few or no passengers. The saloon is at the middle of the vessel, where there is least motion, and is capable of accommodating 260 passengers. The saloon skylight is placed over the music room on the promenade deck, and lights both main saloon and music room. The decoration of the saloon is in polished hardwoods. The music room is paneled in satinwood, birch, and sycamore, and upholstered in Gobelin tapestry. The main saloon is in figured walnut and birch, with upholstery in moquette. The ladies' cabin is in Tynecastle tapestry paneling and silk tapestry upholstery, and the smoking-room, staircases, and entrance hall are in combinations of mahogany, oak, and walnut. The staterooms are all in white enamel, and upholstered in red velvet, the berths and sofas being fitted with spring mattresses. Steerages are fitted for about 700 to 800 passengers forward, and also aft of saloons on both decks.

The cabin and steerage accommodation is heated by steam, and the vessel throughout is fitted up with a double installation of electric light. The machinery consists of a set of triple-expansion engines of the latest design, having cylinders 34 inches, 55 inches, and 88 inches, with a stroke of 54 inches, supplied with steam by three steel boilers at 160 pounds pressure. The "State of California" sails from New York for Glasgow on September 3.—*The Sun.*

Explosions from Unknown Causes.

BY GEORGE ROSS GREEN, E. ORANGE, N. J.

(A Paper Presented at the Cleveland Meeting of Mining Engineers.)

It is often so difficult to locate the causes of failures of machinery and apparatus which can be examined and studied at leisure, that it is not surprising the causes of explosions should escape detection. Usually the explosion is the first evidence that anything is amiss, and the time for observing the conditions is necessarily brief.

An incident in a welding works near Essen, Germany, might be cited as exemplifying what trifling causes may lead to disaster, and how difficult, under the most favorable conditions, it may be to discover them.

A blowing engine was arranged with two suction pipes at each end of the blowing cylinder—one leading to the air, and the other to the gas holder. Each pipe was provided with a valve, and all were so adjusted that the cylinder drew in gas and air in the proportions found most advantageous. The gases from the cylinder were carried directly to the furnace through suitable pipes, and while the cylinder was provided with relief valves, every effort was made to prevent explosions, principally by compressing the gases to a point where the rate of efflux of the mixture was greater than the velocity of combustion, if the expression is here allowable.

It was found that the apparatus would work satisfactorily for some time, and then the relative proportions of the mixture would change, and an explosion might have been the result. Experiments consuming

days were made to discover a method of averting this danger, but they were unsuccessful until it was observed that the change in the composition of the mixture of gas and air took place when the gasometer began to rise or fall—the back pressure due to friction when the holder was rising, or its absence when falling, being sufficient to change the conditions. As soon as this was discovered the remedy was soon found. A metal disk, with a comparatively small hole in its center, was placed in the gas pipe close to the cylinder, and the gas was drawn through this hole, with so much effort that the trifling change in the gasometer pressure was without appreciable effects.

Had an explosion occurred before this discovery was made, it would probably have been classed among the unexplainable.

A blast pipe explosion occurred recently under very similar conditions, and in the same establishment, as that described by Dr. Bayles. I was not present at the time, but I heard the report, and was on the ground a few seconds later. The pipe is 400 feet long, of 16-inch spirally-welded tubes. Air is supplied to the pipe by a No. 9 Sturtevant pressure blower through a Y, 130 feet from one end. The blower is in a separate room, and it draws air through holes in the roof. The pipe is tapped every 14 feet, but the last 70 feet of the longer end was not in use, and formed practically a dead end. Each end, however, of the pipe was closed with a cast-iron blank flange having a hole in its center, through which air was constantly issuing. Any gas that might find its way into the pipe would presumably escape through these holes.

The line had been in entirely successful use about a year, when, one morning in December last, the explosion took place in the dead end. The cast-iron flange was blown into many pieces, several leaving deep impressions in the brick wall, while one piece passed through a stove about 50 feet away. Fortunately no one was seriously hurt. The explosion confined itself to the last 10 feet of the dead end, and especially to the last 18 inches, which were expanded into the form of an irregular sphere—the circumference being 8½ inches greater than formerly—but without bursting the pipe.

It was supposed that gas found its way into the pipe from a special burner that had, however, been successfully used for months; but, supposing this to be the case, why should the explosion take place in the last 18 inches of the pipe, where there was a hole for the escape of gas? Could it have been a dust explosion, and, in either case, what ignited it? No further trouble has been experienced, although the conditions remain the same, so far as known.

An explosion took place in the purifier house of The Sherbrook Gas and Water Company's works a few months ago, under rather peculiar circumstances, and the facts in this instance may serve to illustrate other dangers of gas purification than those in the paper under discussion.

This company has two holders; and when one was about filled, an employe was sent to turn the gas from this into the empty one. He however, closed both valves, and the gas broke the seals in the purifiers and escaped into the room. This room adjoins the generator house, and is separated from it by a heavy brick wall, there being neither doors nor other communication between. An employe from outside started into the purifier room, and upon his opening the door, an explosion immediately took place; the building was wrecked, and one man was killed by falling walls.

Investigation showed that there was no fire in the room, and the explanation that the explosive mixture had escaped into the generator house through the wall, and had there become ignited and communicated the flame to the gases in the purifier room, was not at all satisfactory to the gas company.

The matter is still under investigation, both by the gas company and the local authorities.

This company has experienced several small explosions which they can account for in no other way than by the theory that gas and air in certain proportions and under certain conditions are spontaneously explosive.

Explosions attended with more or less mystery occasionally occur in the sewers of cities. These explosions are due to illuminating gas which has escaped from the mains and collected in the sewers and subways.

How it becomes ignited is usually not known—a spark from a horse's hoof or a lighted cigar has been advanced as a possible source of fire; but many of these explosions occur under conditions which necessitate our seeking other explanations.

However closely the engineer may investigate, he must acknowledge that there are many things connected with gas explosions which are yet to be learned. During my investigation of this subject, engineers have suggested pyrophoric iron in the oxide as a cause of purifier explosions; others suggest pyrites; and others again speak vaguely of certain subtle and unstable gaseous combinations which are readily dissociated, and cause spontaneous combustion.

While this last theory is not one that the average engineer is willing to accept, yet from the evidence presented he may draw one conclusion: it is not possible to be too careful. Many of the gas explosions which seem so mysterious are no doubt due to quite simple causes which perhaps are overlooked because so obvious.

Another point presents itself: none but the most careful and thoughtful men should have charge of work in gas plants. I saw a private water gas plant in Brooklyn a year or so ago being operated for pure water gas. The man in charge, however, was blowing air through the coal at the same time that he was passing steam; and he was entirely unconscious that the product was a mixture of producer and water gases. He had erected and piped the apparatus himself (without any previous experience whatever in gas manufacture), and had it so arranged that an explosion was both possible and probable. That he had escaped one, can be attributed only to the habit of this subtle and insidious compound to do the unexpected.

John Wiley & Sons, New York, write us in reference to a recent question and answer in the AMERICAN MACHINIST, that they publish "Wilson on Steam Boilers," with additions by Prof. Flather; a fact we well knew, but which was overlooked.

The Speed of the Steam Launch "Norwood."

On the 19th inst. a small steam launch, called the "Norwood," ran a race with one of the fast Sandy Hook boats—the "Monmouth"—down through the bay to Sandy Hook, beating her larger rival very handsomely, and developing such remarkable speed as to attract very general attention.

The next day about all the newspapers appeared with accounts of the run, in which the statements were made that the boat had been designed and built by C. D. Mosher, of Amesbury, Mass., a year ago, but had not developed the required speed until after being altered considerably by others. This seems to call for a statement of fact by us.

In our issue of Sept. 18, 1890, we published some account of this boat, in which we said that at a preliminary speed trial she had shown a speed of 30 miles an hour, which, if true, would be at least as fast as the speed claimed during her run of the 19th, and, in fact, somewhat faster than there is any positive evidence of. To substantiate our original statement, and also as a matter of justice to Mr. Mosher, we append a copy of a letter, the original of which we have seen:

AMESBURY, MASS., Sept. 10, 1890.

This is to certify that on July 8th, 1890, I was one of the persons on board at the trials of the steam launch "Norwood," built by Mr. C. D. Mosher, of Amesbury, Mass., and that during a two hours' run she did develop a speed of thirty miles per hour over the Wannesquam Boat Club course, and that she did make one mile in one minute and fifty-eight seconds, and this speed agreed by the watches of each of the gentlemen aboard.

(Signed)

C. F. TIBBETTS,
Amesbury Manager *Newburyport News*.
GEORGE C. PERKINS,
Engineer Electric Light Station, Amesbury.
N. S. HOYT,
Dealer in Windows and Blinds, Amesbury.
C. H. FOLSOM,
137 Greene Street, New York City.

The evidence seems to be pretty conclusive that the boat has not only previously made considerably above her contract speed of 25 miles per hour, but that while in the hands of her builder she made better speed than was made during her recent run to Sandy Hook. Nearly a year ago a race with the "Monmouth" had been arranged for, and after some preliminary dock trials, in which the machinery had been found to work perfectly, Mr. Mosher went on board the boat to engage in the race, and found that a rock shaft was twisted in such a way as to throw the high-pressure valve out of adjustment, and he could not make repairs in time for the run. Mr. Monroe, for whom the boat was built, was on board the "Monmouth" with some of his friends, and of course was considerably disappointed at not seeing the launch. A bill of sale had previously been made, and Mr. Mosher has not been allowed on board the launch since that time. According to the contract he was to receive $2,000 bonus for each mile of speed per hour above 25.

To Collect and Deliver Parcels.

A company has been organized to collect and deliver parcels in this city, on much the same plan as the London Post-office Parcels Delivery system. Collection boxes, about five feet high, are to be distributed in convenient localities about the city in which to deposit the parcels, and they will be collected and delivered every hour. Parcels must not exceed fifteen pounds in weight, and the charge for the service will be fifteen cents each, which is to be prepaid by affixing on the parcels the company's receipt stamp for that amount. These stamps will be for sale at places indicated on the collection boxes, and persons will also be able to purchase them from the company's drivers. The company has been incorporated under the laws of West Virginia, and it is claimed by its promoters that it will supply a long-needed promptness and economy in the delivery of small packages. Its general office is at No. 434 Broome street. Subsidiary companies are to be organized to do the same work in other cities. The capital stock of the Parcel Express and Messenger Company is $150,000, and Joseph L. Robertson is its president. It expects to begin business in October.—*Evening Post* (New York.)

The report comes from the West that the experiments being made there by the Department of Agriculture for the artificial production of rain have been entirely successful, and although it is of course too early as yet to say just what the possibilities and limitations of the new science may be, it is evident that there is at least a fair chance of being able to produce rain when needed, under certain conditions, and at a cost far below its value to the growing crops. The importance of the discovery, if it shall prove to be practicable, can scarcely be over-estimated.

The method tried is simply acting upon the suggestive fact, long ago noticed, that rain almost invariably followed a battle or heavy cannonading. Hydrogen gas is liberated from balloons at a height of a mile or more from the surface, and dynamite exploded from kites flying a thousand feet high. At the same time rend-rock is exploded on the surface of the ground. If the practice of rain making should become general its effects would be felt far beyond the agricultural interests, for it would lead to the development of vast tracts of territory in which farming is now unprofitable, and it is the development of new territory more than anything else which has given us our phenomenal prosperity in the past.

A Chicago dispatch says: Another "national" building and loan association has come to its natural end. Alfred Downing, president, and N. H. Tolman, vice-president of the National Capital Savings Building and Loan Association of North America were arrested in Chicago yesterday by Post-office Inspector Stewart, charged with using the mails for fraudulent purposes. It is charged that the men who have been conducting this association have swindled thousands of people from every State in the Union, and have taken from $200,000 to $600,000 and given nothing in return. The general manager was L. F. Mortimer. The system was the usual "national" one—securing members on the promise of loans, and not making the loans

Machinists' Supplies and Iron.

NEW YORK, August 22, 1891.

Iron—American Pig—The market continues to rule unusually dull, and values are decidedly weak. We quote: Standard Northern brands, No. 1 Foundry, $16.75 to $18; No. 2, $15.50 to $16.50; Gray Forge at $13.90 to $15. Southern brands of good quality are quoted at $16 to $17.50 for No. 1 Foundry; and $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote Coltness at $23, Eglington, $20.50.

Copper—Very little is being done here, and the local market is quite dull. If it were not for the firm tone abroad prices would undoubtedly fall considerably here. Values for Lake are 12c. to 12¼c. Arizona Ingot, 12c. to12⅛c. Casting Copper, 11¾c. to 12⅛c.

Lead—There is little or no business being transacted, and buyers seem to show very little interest. Values of Pig are nominal at 4.45c.

Spelter—No business to speak of has been transacted during the week, and supplies are accumulating. Values range at 5c. to 5.05c.

Tin—There is some improvement in the general condition of the market, this being due in part to firmer advices from abroad. Values for spot rule at 20.10c. to 20.15c.

Antimony—There is no change in the local market. We quote Hallett's, 10½c.; Cookson's, 13½c.; L. X, 11½c.

Lard Oil—The market is steady at 53c. for Prime City. Western, 52c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Mechanical draftsman, good designer, wants situation. Address Box 41, AM. MACHINIST.

Wanted—A 1st-class draftsman and machine designer, with experience. Box 45, AM. MACHINIST.

Agents wanted for the finest & best surface gauges; large profits. E. G. Smith, Columbia, Pa.

Experienced man, shop, drawing-room and erection of mach'y, wants position. W. W., AM. MACH.

Wanted—Machinists to work on steam engines 2 to 20 horse-power. Apply to Troy Engine and Machine Company, Troy, Pa.

Wanted—1st-class rivet maker; one who can make dies and take charge of three machines. Ohio Falls Rivet Company, 521 Third street, Louisville, Ky.

Mechanical engineer (mem. A. S. M. E.) competent to take charge of mfg. establishment, desires position in any part of country. Buffalo, AM. MACH.

Spanish correspondent desires position; formerly engaged in S. American trade; N. Y. refs. Address Correspondent, Ivor, Virginia.

Wanted—A first-class blacksmith to take charge of shop doing marine eng. and car work. The Harlan & Hollingsworth Co., Wilmington, Delaware.

Bicycles. Young man, experienced draftsman and designer on bicycles and cycle tools, would change position. X. Z., Box 33, Chicopee Falls, Mass.

A good, practical draftsman, just finished two years with last employers, seeks engagement, etc. M. D., care AMERICAN MACHINIST.

Young man, good draftsman and general machinist, wants permanent situation as draftsman or foreman. Address Permanent, AM. MACHINIST.

An experienced engineer and mechanical draftsman will be open for permanent engagement. Address Experience, AMERICAN MACHINIST.

Wanted—Situation by machinist, experienced in building and running experimental machy.; also in handling help. 1st-class refs. Box 46, AM. MACH.

Wanted—Mechanical eng; acquainted with engine business, as salesman; state age, exp., and salary required. Robt. Wetherill & Co., Chester, Penn.

Sup't wanted for shop manufacturing machine bolts; must be a good mechanic, and thoroughly accustomed to handling men. Address, stating age, exp., and refs., M., B. & Co., Box AM. MACHINIST.

Mechanic of extensive exp. and ack'd ability, accus'd to supervision of work and management of men, good designer and draftsman, desires a responsible position after Sept. 1st. Box 43, AM. MACHINIST.

Wanted—A position as foreman boiler maker, or laying out work in a marine shop, by a practical man of long experience and thorough capability. Address Capable, AMERICAN MACHINIST.

Wanted—A competent salesman for the machinists' tool and supply trade; preference given to those having an established trade. State salary expected and approximate of sales per annum. H. E. Rogers, Box 879, N. Y. City.

Wanted—To correspond with parties in need of a practical millwright and erecting engineer, or will take charge of a good steam plant; well up in steam machinery; Va. or Tenn. preferred; age 30, married; best refs. Hustler, AMERICAN MACHINIST.

Draftsman, familiar with modern shop practices, a designer of machine tools and special machines, tools and fixtures for manufacturers, now holding responsible position, desires to make a change. N. Y. City or vicinity preferred. K. Z., AM. MACHINIST.

Wanted as instructor, an M. E. graduate with experience in the designing of machinery and testing of steam plants. Must be able to begin work Sept. 9. Address Prof. Mech. Eng., 357 Market St., Bethlehem, Pa., stating past exp. & salary expected.

Wanted—Supt. for a machine shop near New York; an energetic, systematic man with a technical and practical education, and a thorough knowledge of the requirements of interchangeable work will find an excellent opening. Address in writing, stating exp. and refs., X. Y. Z., AM. MACHINIST.

Wanted—A first-class brass finisher to take the position of foreman in a large shop, where every description of engineers' and plumbers' brass work is manufactured; men competent in every respect to fill the position only need apply. Apply by letter addressed "T" to the AM. MACHINIST, and state experience, and salary expected.

Wanted—A good machinist who has had some experience as a traveling salesman, and who is willing to engage with reliable parties to travel a part or all of the time. Please state particulars in regard to past experience, give references, and state wages expected. Address BOX 44, AMERICAN MACHINIST.

Wanted—A first-class engineer, who is also a first-class machinist, to take charge of electric lighting and steam plant; must be fully capable of doing his own repair work, and must have had experience in this line; wages, $18 per week. Apply in person or by letter, with references, to Jno. P. Conkling, Lyon Mountain, N. Y.

Wanted—A 1st-class foreman for a floor of 50 hands on medium and light work. Must have good judgment, executive ability, and be well posted in the modern methods of getting out work of a good grade economically. A good opening for the right man, who must be thoroughly competent. Address, with age, experience, and salary expected, Baltimore, care AMERICAN MACHINIST.

A young mechanical engineer, 24, first-class draftsman and designer, experienced in high-speed and Corliss engines, machine tools, foundry appliances, special automatic labor-saving machinery and mill engineering, employed in best shops and manufacturing concerns East and West, desires to change for responsible position as designer, superintendent or master mechanic. Kinetics, AM. MACH.

Wanted—A young graduate with a good theoretical knowledge of electricity and drafting, who would like to spend a year in applying his knowledge where there are good facilities for perfecting himself as a designer of electric machinery. Must have some natural talent, and enough theory for designing electric motors, etc. Salary small for first year. Address, with refs., Graduate, AM. MACH.

An experienced pattern maker and mechanical draftsman, at present holding position as foreman, desires to make a change. Best of references. Address P. M., AMERICAN MACHINIST.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Drawing made for Corliss and Slide Valve Engines and Gen. Mach'y. A. W. Jacobi, 136 Liberty St., N. Y.

Working drawings of machinery and plans of mills drawn. Address Box 40, AMERICAN MACHINIST.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

Wanted—Agents for the Machinists' Hand-book on lathe screw cutting, figuring speed, setting valves, etc., etc. Price 50 cts. Loetzer & Bynon, Sayre, Pa.

Fine Automatic Machy. Punch, Die & Screw Mach. Work Specialities. Send sample for low estimates. Novelty Mach. Works, Orange, N. J. P. O. Box 434.

For Sale Cheap or Exchange—Eleven right and left modern Patent Automatic Cut-off Engine Patterns & Drawings, from 10" to 20". B 9, AM. MACH.

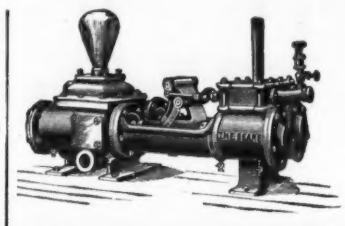
For Sale—Three 3-ton jib cranes, 20 feet height of mast, swing in space of 35 feet. Apply to The J. Morton Poole Company, Wilmington, Delaware.

Machine shop and boiler shop, with all necessary tools, for sale or rent; located at West Point, Pa., twenty-four miles from Philadelphia. For particulars address D. C. Wismer, Quakertown, Pa.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Wanted—One or more men to become interested in a patent boiler. Best boiler in the market. None only those meaning business need answer. Wm. C. Codd, 2010 and 2012 Aliceanna Street, Baltimore, Md.

To lease, or owners would capitalize in a stock company, factory in New England, adapted to manufacturing fine machinery. Plant covers over 100 first-class machines. Factory 2 stories, surface area each floor 12,000 sq. ft. Factory AM. MACH.



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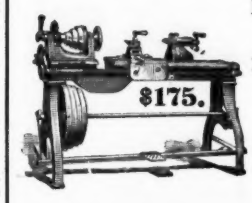

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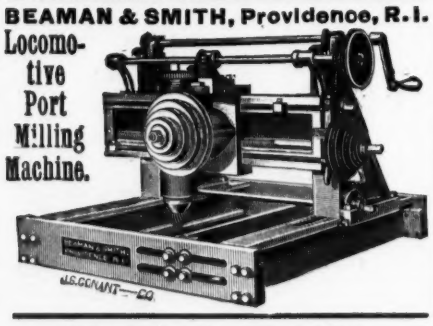

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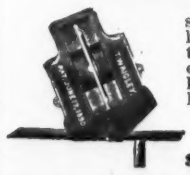

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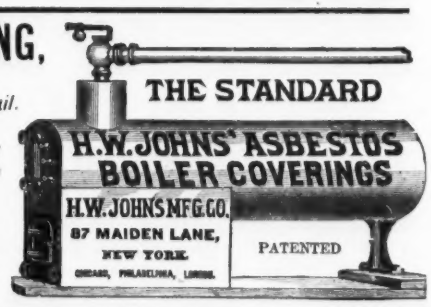

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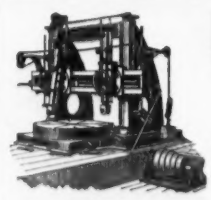

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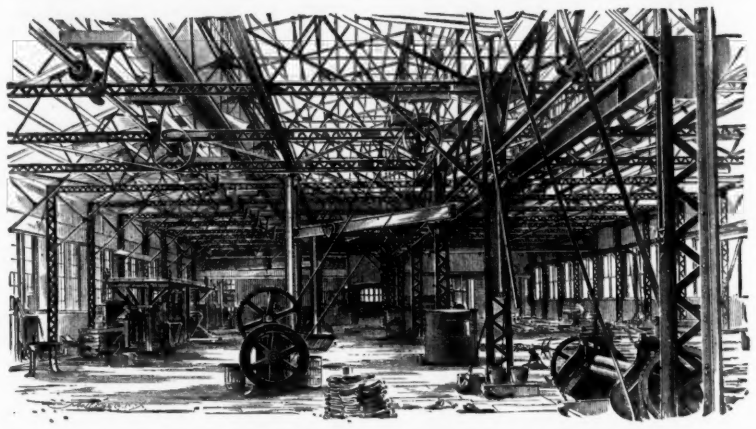

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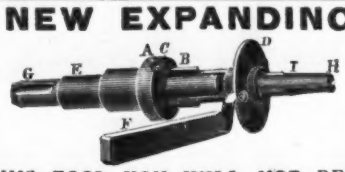

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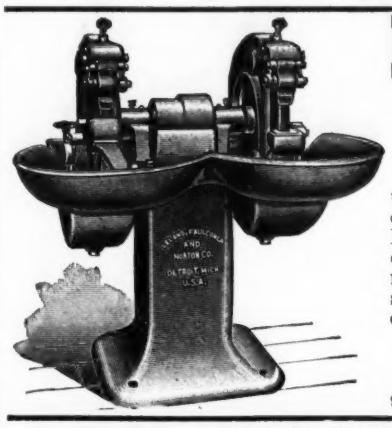

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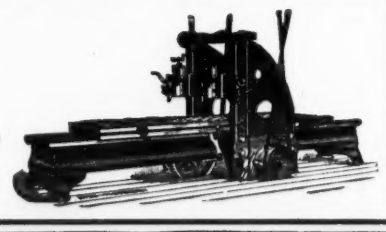

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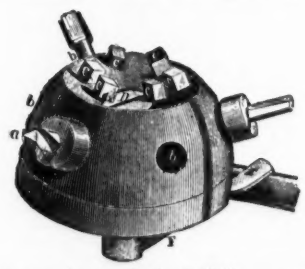

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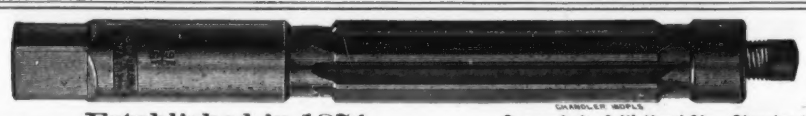

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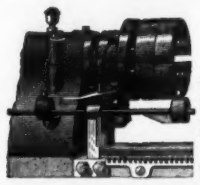

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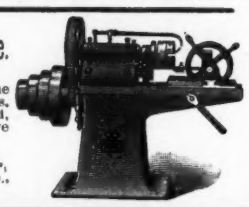

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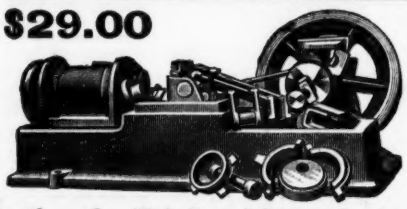

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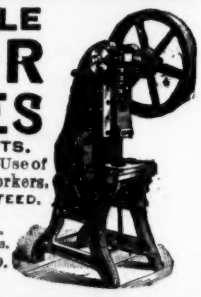

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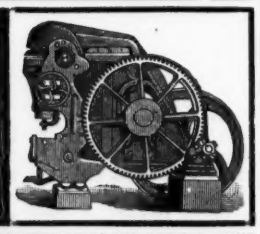

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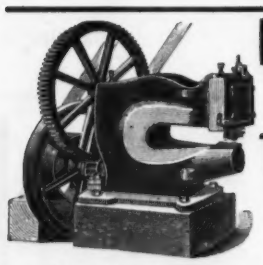

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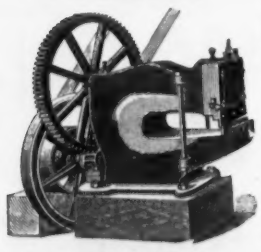

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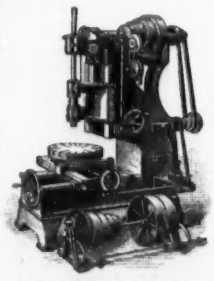

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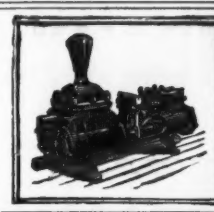

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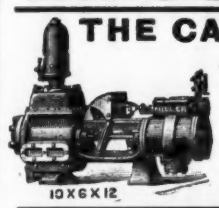

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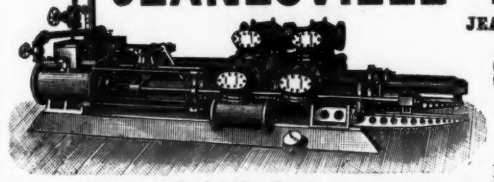

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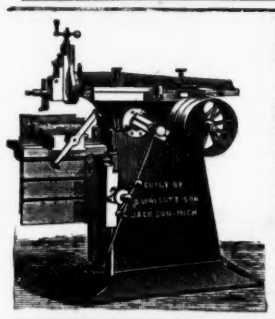

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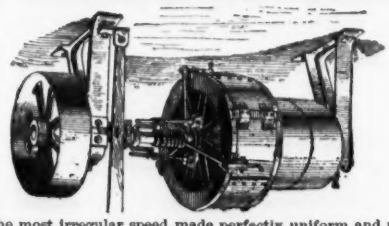

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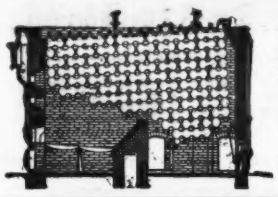

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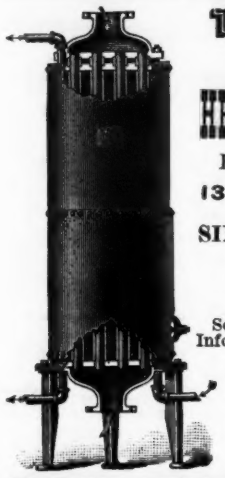

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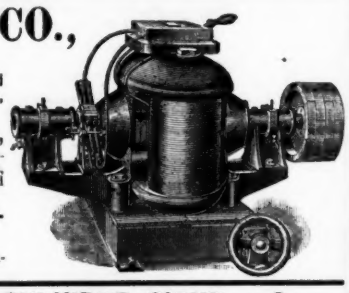

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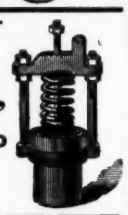

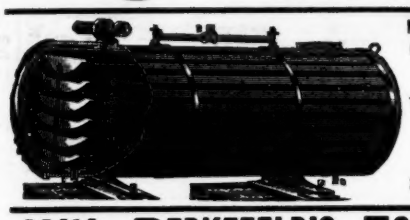

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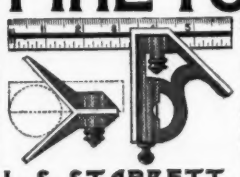

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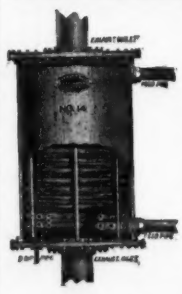

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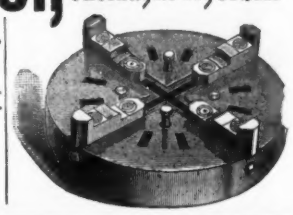

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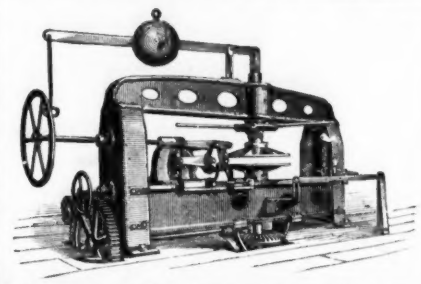

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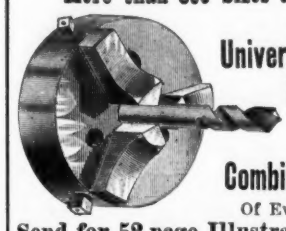

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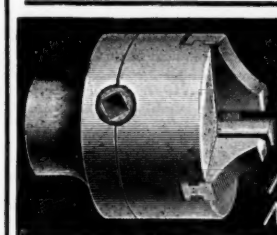

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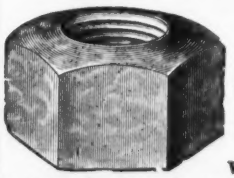

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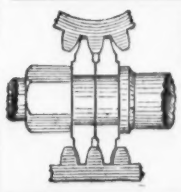

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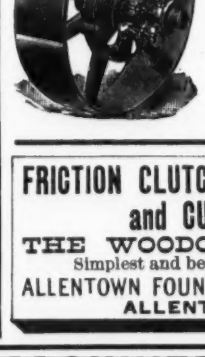

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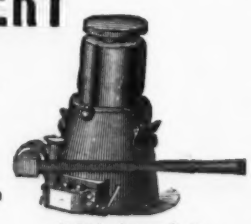
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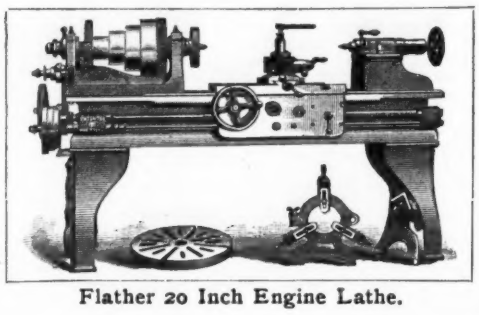

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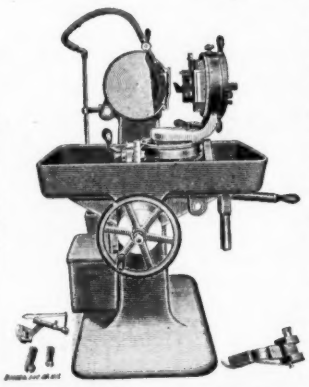

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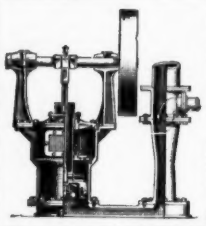

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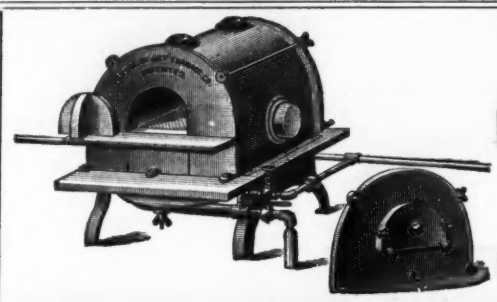

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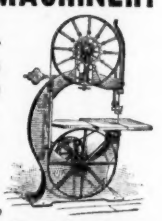

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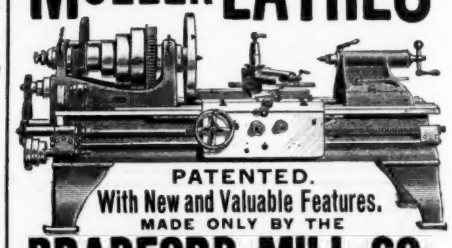

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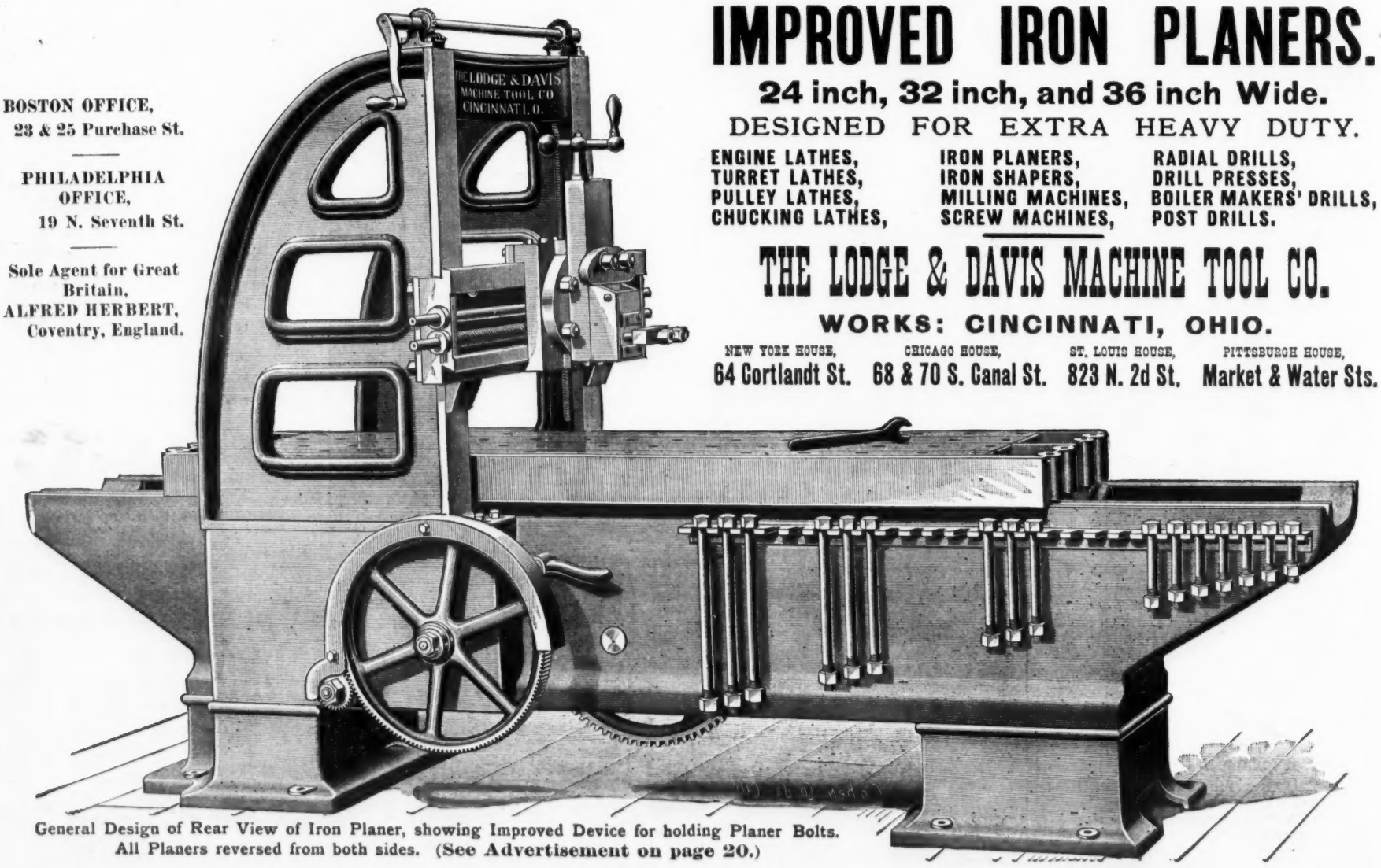

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General Design of Rear View of Iron Planer, showing Improved Device for holding Planer Bolts. All Planers reversed from both sides. (See Advertisement on page 20.)

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Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
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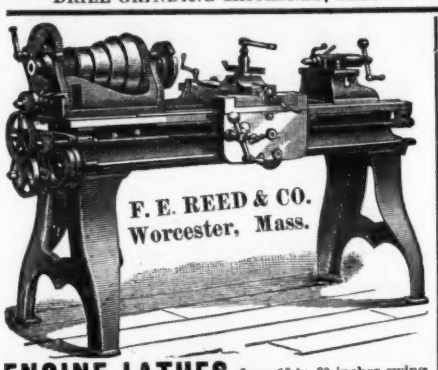

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Also Hand Lathes, Foot Lathes and Milling Machines.

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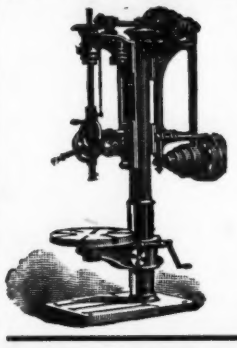
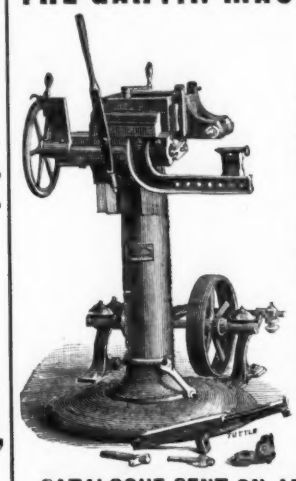


Lathes, Planers, Shapers, Slotters, Etc.

THE GARVIN MACHINE CO.



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This handy little machine is intended for rapid and convenient cutting of light gears, ratchets, etc., used in telegraphic and mathematical instruments, etc.

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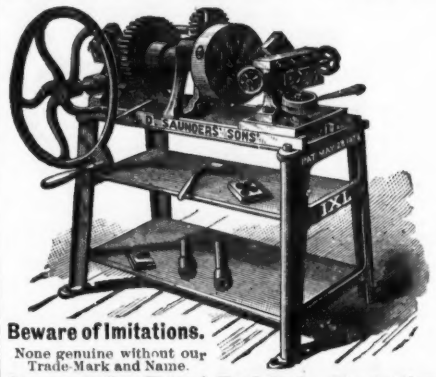

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14, 15, 16, 18, 20, 24 and 28 INCH SWING.
ANY LENGTH OF BED DESIRED.

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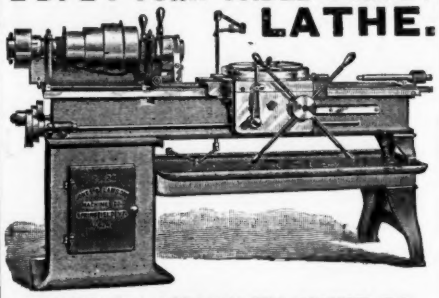

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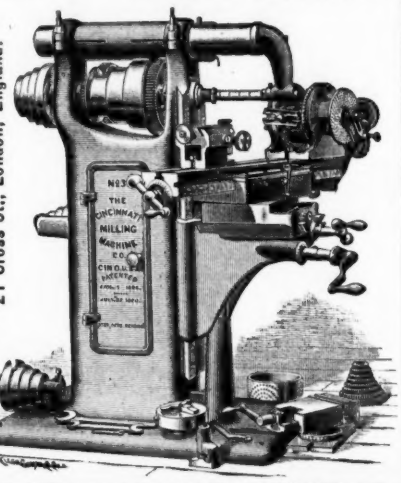

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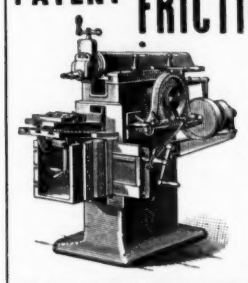

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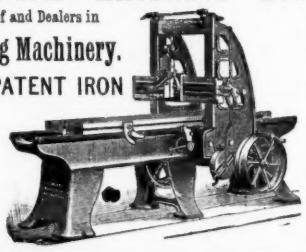

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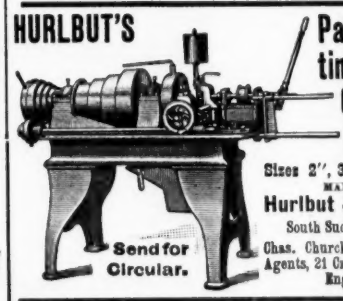

Patent Cutting-off and Centering Machine.
Sizes 2", 3", 4", 5", 6".
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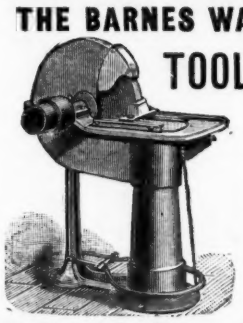

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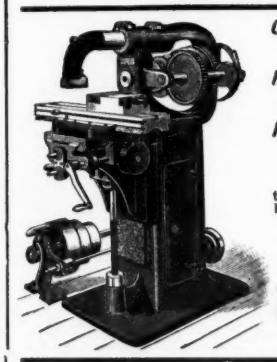

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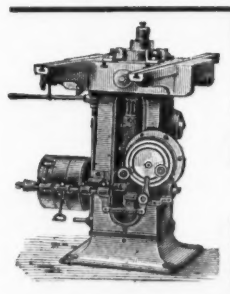

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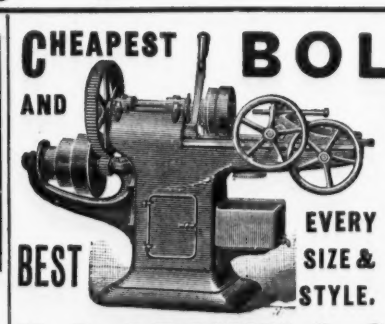

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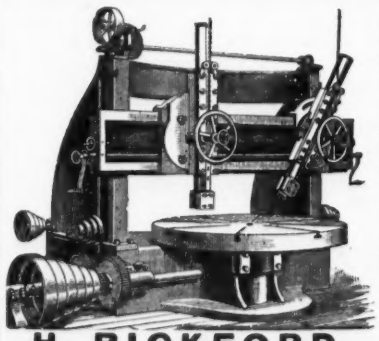

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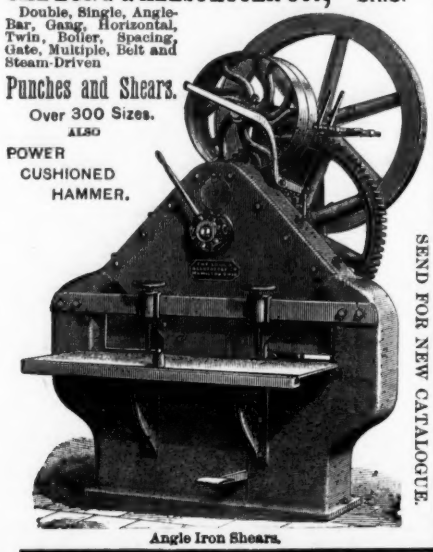
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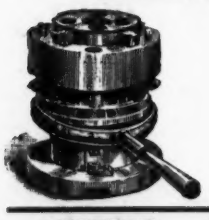
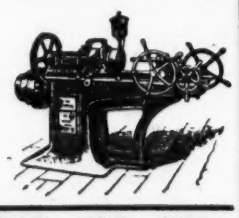

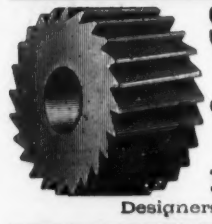
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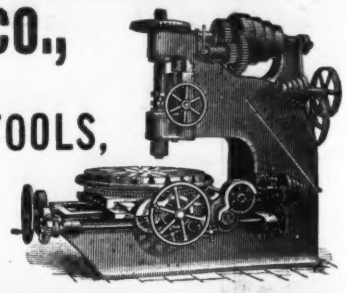

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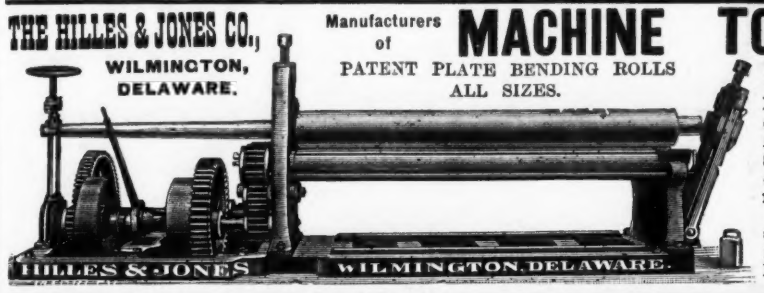

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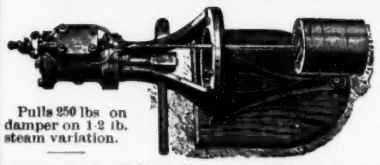
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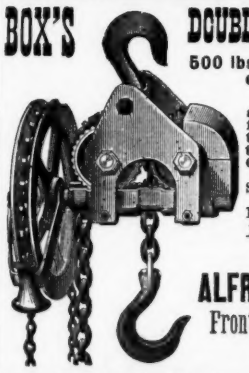
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Designed for either **straight** or **curved** work.
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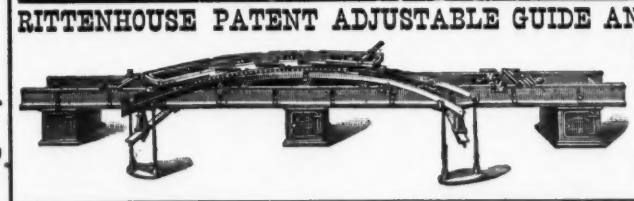
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BUILDERS OF THE
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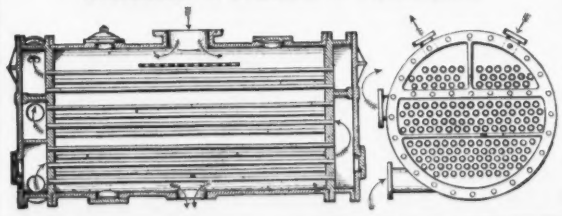
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The Straight Line Centrifugal Separator
was **NOT** included in the test recently made at Cornell University. A claim is made in another Journal that Separator **B** showed the greatest efficiency due to corrugations of interior surfaces. We not having shown our Separator in the above mentioned test, it might lead the general public to imagine we do not possess the best Separator, which we claim we do, and can show greater efficiency than any Separator on the market, in a competitive test where all Separators are represented.
I respectfully request interested parties to investigate this theory to substantiate this claim.
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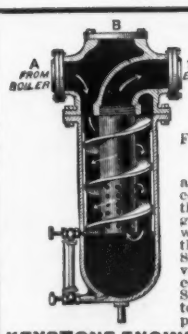
NEW YORK.



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For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
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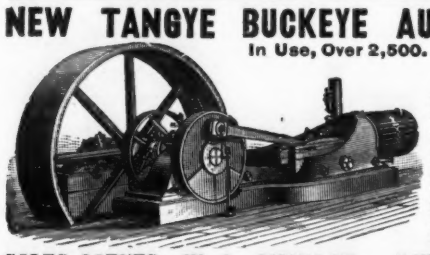

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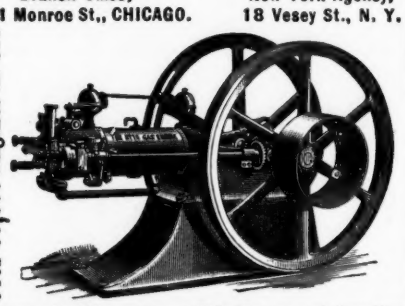

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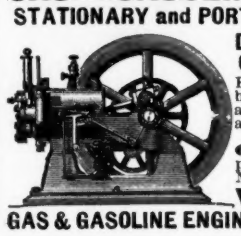

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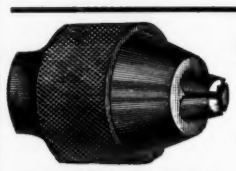

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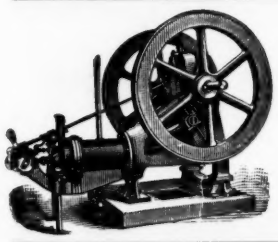

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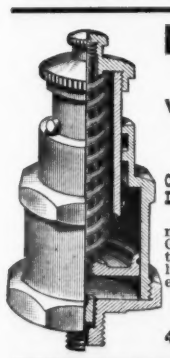

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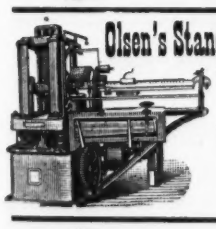

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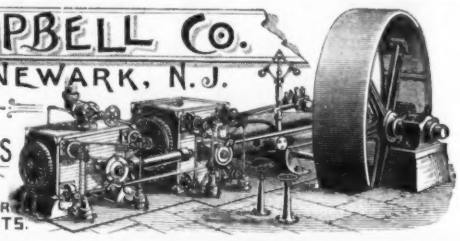

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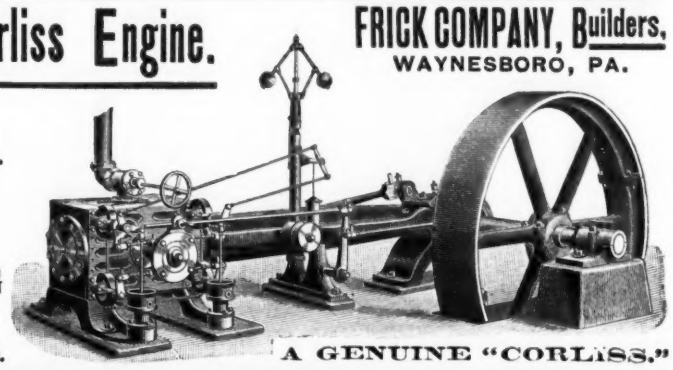

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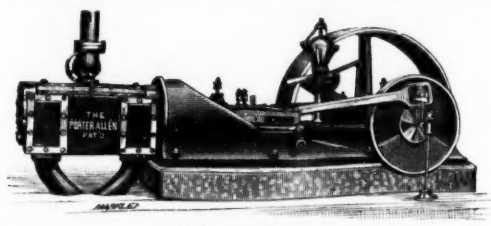

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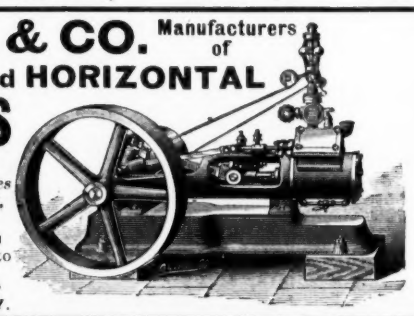

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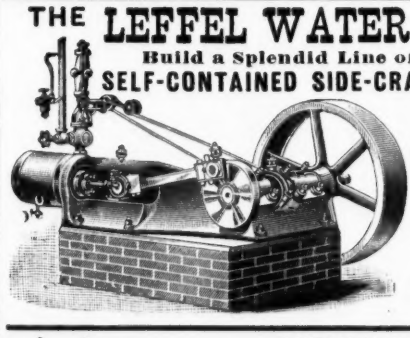

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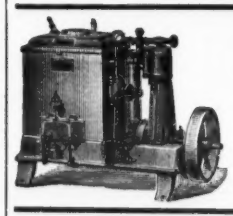

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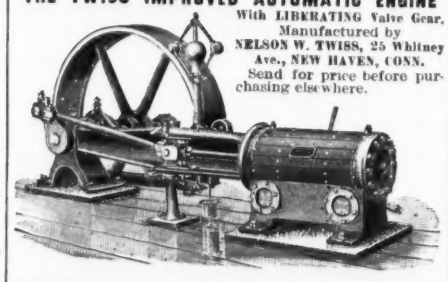

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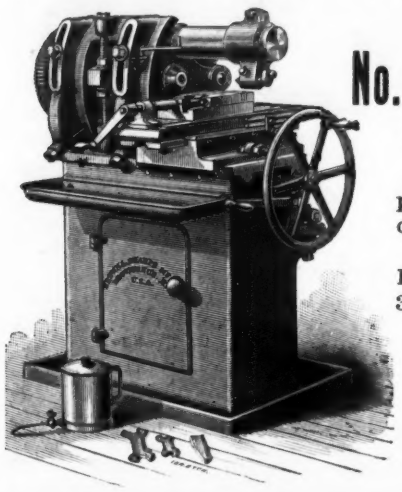

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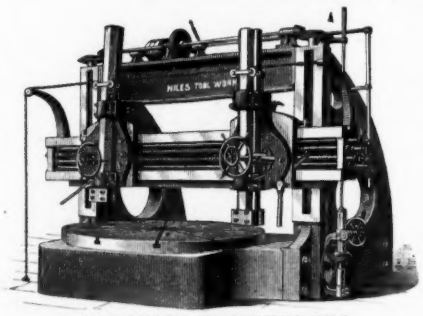

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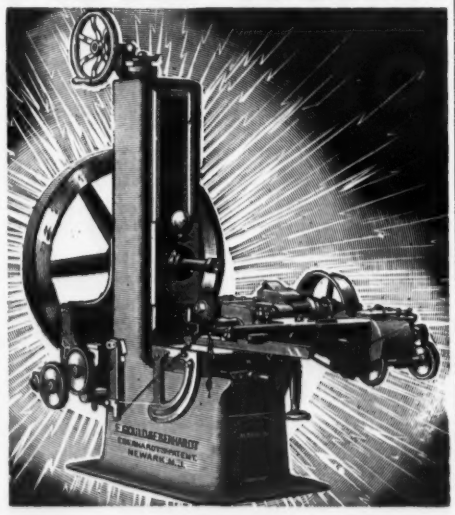

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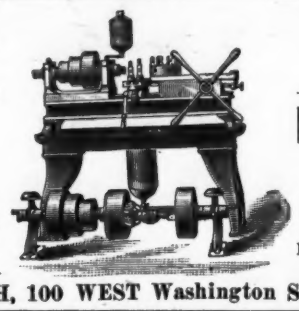

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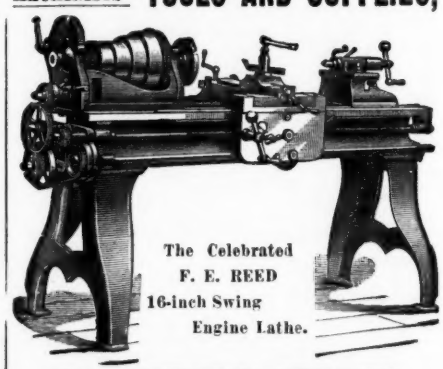

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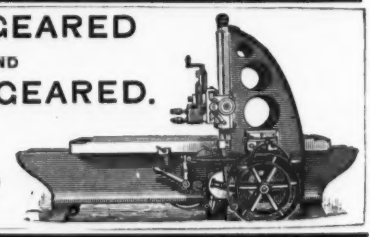

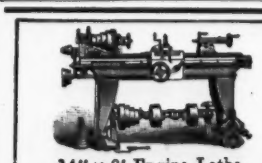

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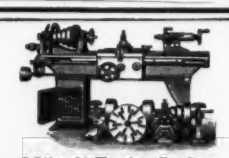

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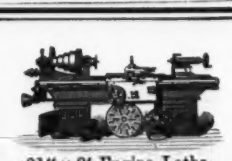

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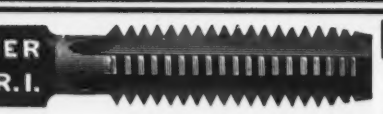

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